Social Impact Assessment in a developing context: A case study of the upgrading of the Olushandja Dam, northern Namibia.

A study commissioned by the Department of Water Affairs Government of Namibia

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Executive Summary

The Olushandja Dam, situated in far northern Namibia, forms an important component of an international water transfer scheme. In the past, this reservoir has not been used to store water at its maximum capacity. An upgrading project has been proposed by the Namibian Department of Water Affairs (DWA). The project will entail significant fluctuations in the level of the dam with implications for the adjacent human settlements. These comprise rural communities who have come to depend on the dam as a valuable source of water. A impact analysis has been commissioned to examine the potential social effects of the upgrading scheme and identify ways of mitigating negative impacts, and enhancing opportunities for the surrounding communities. The social assessment forms a component of an environmental impact assessment (EIA) commissioned by the DWA in December 1994.

The Olushandja Dam was designed as part of system to supply the densely populated former Owamboland in northern Namibia with water from the Cunene River which, in part, forms the border between Namibia and Angola. The transfer scheme was initiated in 1969 by an agreement between the respective administrations of Namibia and Angola which gave each country rights to 50%of the flow of the Cunene River. Prior to the implementation of the transfer scheme, citizens of Owamboland were entirely dependent, for their subsistence way of life, on a seasonal supply of surface water. This supply is concentrated in numerous shallow water courses, known as *oshanas* which drain southwards to the Etosha pan. The more reliable supply from the Cunene River is necessary to sustain development in the face of recurrent drought and a substantial increase in population pressure.

Water is extracted from the river at the site of the Calueque Dam in Angola and pumped via a canal into the Olushandja dam. This reservoir provides a mechanism for balancing storage of a reserve supply of perennial water closer to the consumer points in Owambo. Water is distributed from the site of the Olushandja Dam via a network of canals and pipelines to Owambo communities situated to the east and south of the dam. Although construction of this scheme was initiated in 1970, its completion has been repeatedly delayed by effects of a prolonged armed struggle that took place in the region before Namibia gained Independence. In 1994 construction activities resumed on the Namibian side of the border and Namibian Department of Water Affairs plan to utilise the full storage capacity of the balancing reservoir in anticipation of the transfer of $6m^3$ of water per second from the Cunene river. This is the maximum amount stipulated in the 1969 agreement with Angola. Presently the Olushandja Dam operates at approximately 30% of capacity (Haussler, pers. comm., 1995).

Although the supply scheme itself is quite unusual, both the social and political context of the project is characteristic of developing countries for a number of reasons.

Firstly, from a political perspective:

- The upgrading scheme will be financed through external aid from the Dutch government. An EIA or SIA is a proviso for the receipt of such aid. The assessment will consequently be used by the project proponent as justification for the envisaged upgrading scheme.

- Namibia has relatively recently gained Independence in 1991, following a prolonged period of internal and external conflict which can be traced back to colonial expansion. A number of legislative and administrative functions of the government are consequently in a state of flux. The responsibilities of the various government departments are ill-defined making it difficult to access required information for the SIA and identify bureaucratic channels at which to aim mitigatory suggestions and recommendations. These problems are compounded by the recent establishment of magisterial districts and the election of political councillors, in response to the democratisation process. These tend to conflict with local tribal boundaries and the role of traditional authorities in rural areas.

- The upgrading scheme is associated with significant regional benefits for the 44% of the national population who inhabit the north-central regions. Such macro-economic and social benefits are easily highlighted at the expense of addressing local impacts on particularly vulnerable sectors of society.

Secondly, from a social perspective

- Community organisation, beliefs and attitudes amongst rural Owambo communities are closely integrated with people's dependence on the environment for their subsistence. The close relationship between people and their natural surroundings blurs the distinction between biophysical and social impacts of development. The role of social scientists in an environmental assessment cannot, therefore, be restricted to specialist input regarding the social and demographic profile of an affected environment.

- When affected parties comprise isolated rural communities in traditional environments, members of social impact assessment teams are inevitably "outsiders" to the communities. There exists, therefore, a significant perceptual gap not only between communities and the project proponents, but also between the communities and the assessors. It becomes difficult for researchers to overcome suspicion and prove their allegiance to the community

- Affected communities in rural areas are also characterised by a distinct set of cultural and social values. It can therefore not assumed by the assessors that their values and assessment of priorities accurately reflect those of the affected public

social values. It can therefore not assumed by the assessors that their values and assessment of priorities accurately reflect those of the affected public

EIAs and SIAs in developing countries are inevitably associated with one or more of these social and political limitations, particularly in southern Africa. Furthermore, there are few African case studies to guide the researcher under these circumstances. It is clear that the implementation of SIAs in developing countries cannot merely involve the transfer of institutionalised approaches and methodologies developed in western industrialised countries. Such approaches and methods have been formulated largely in response to NEPA legislation and may be incompatible with social and political structures in developing countries.

Adaptations of the EIA procedure have been proposed for conditions associated with development. This is demonstrated by the Integrated Environmental Management (IEM) procedure developed by South Africa's Council for the Environment (1992). The recently introduced Namibian Environmental Assessment Policy (1995) is based on IEM. Despite the intended flexibility of the IEM procedure, it cannot act as the ultimate solution to the number of complex problems and variables which characterise a study such as the present SIA. Fundamental to the IEM procedure is the early consideration of alternatives and the integration of environmental concerns into planning and management from the conceptual and design stage of a development project (Fuggle, 1991). Often projects are identified on the basis of engineering and economic feasibility and an environmental component simply has to be added in response to requirements of external funding agencies. This situation mitigates against early consideration of alternatives. External agencies are chiefly concerned with fulfilling NEPA requirements rather than those of IEM.

There is unlikely to be an ideal model that may cater for the number of complications involved is such an assessment. In the face of unavoidable obstacles to the comprehensive adherence to an IEM type procedure, SIA should realistically aim to ensure that decisions are transparently motivated as based on the best, most appropriate knowledge that can be elicited about the affected environment. Practitioners will inevitably have to draw on a variety of techniques and lessons learnt elsewhere. More importantly, they must be prepared to acknowledge a degree of subjectivity in the evaluation procedure and appreciate their own role in the process of development.

The method of data collection and evaluation employed in SIA of the upgrading of the Olushandja Dam was aimed at addressing some of the limitations associated with SIA in a developing context. Most importantly, a fundamentally political, as opposed to a purely quantitative or technocratic approach to the SIA is advocated. This approach essentially subjective, orientated towards qualification of information and concerned with improving communications between local people and external decision-makers. Methods used in justification of this approach focus on a high degree of public involvement of members of Owambo communities in the study area.

Prior to the undertaking of fieldwork, efforts were made by the study team to access as much existing data on the affected environment as possible . These comprised an extensive literature review and consultations with SIA specialists, NGO representatives and organisations working in and around the affected environment. Much factual information about social organisation and agricultural practices was extrapolated from previous studies of other Owambo communities. This can be justified on the basis of political and cultural homogeneity among the Owambo people (Tapscott, pers. comm,1995). Repetitive data collection and impersonal questions aimed at eliciting factual information could consequently be under-emphasised in information gathering process. The social survey used in the study was aimed largely at determining people's perceptions, attitudes, fears and suspicions regarding the Olushandja Dam. An attempt is made to incorporate these factors into a framework that allows for the interaction between formal and informal approaches as a means of achieving acceptable decisions regarding the sustainable management of the Olushandja Dam. Emphasis is placed on the perceptions of communities as shaped by their cultural development and more recent social and political history

Open-ended household interviews were conducted among residents of the area around the Olushandja Dam within a radius of 10km. The questionnaires were designed to extract qualitative information relating to how dam construction had changed the lifestyles of people living in the study area and how envisaged fluctuations in water levels of the reservoir will affect these communities. Information from the household interviews was supplemented with responses from key informants such as school teachers, church leaders, health workers and tribal authorities who live and work in the study area. An additional investigative technique, namely land-use mapping, drawn from the recently developed body of methodology known as PRA, was employed during an informal group workshop. The workshop was aimed at identifying community values and priorities which would help ensure the success of the project. It was also designed to create an avenue for empowerment of local communities in the decision-making process.

Issues and concerns identified by the community during household discussions and the community workshop formed the basis for the identification of significant social assessment variables that would be affected by the upgrading of the Olushandja Dam:

- **Aspects of community health and well-being.** An increase in volume of water will expand the breeding area for secondary host organisms to parasites causing diseases such as malaria and bilharzia. The latter may affect humans and livestock. The occurrence of gastro-intestinal illness in the study area may also be attributed to the consumption of raw water from the dam.

- **Fishing activities.** Impoundment of water in the Olushandja Dam provides one of the only perennial or permanent habitats for fish and aquatic life in Owamboland. Community members in the study area are dependent on fish as a source of income and a source of protein. The upgrading scheme could hold implications for fish production and distribution.

- **Water quality and accessibility.** The members of over 600 households depend on the dam as their only source of water in the dry season. Access to this supply is affected by the level of the dam as is the quality of the water. The nature of the poor area to volume ratio of the dam promotes high levels of turbidity and salinity with consequent implications for drinking water.

- **Housing and settlement patterns.** The dam is unusual in that it is very shallow, characterised by high evaporation loss and low efficiency. Constructed in an *oshana* watercourse, the dam has both a north and south wall. Owing to the very low gradient of the surrounding landscape an increase in volume will cause a disproportional increase in area. This will result in the inundation of a number of households as well as two market gardens on the banks of the dam.

- **Patterns of social organisation and movement.** Impoundment of water in the Olushandja Dam has created a barrier to community interaction and restricted the movement of cattle.

- **Silvipastoral farming**. Owambo communities practice a combination of tree tenure, pastoralism and subsistence agriculture, the staple food crop being millet (*mahangu)* or varieties thereof. The creation of a permanent supply of water has held some implications for people's dependence on the natural resource base. More importantly, it has introduced potential for irrigation of agricultural fields which would enable crop production to continue throughout the dry season with significant social and biophysical implications.

The investigation of these social variables comprises an evaluative as well as predictive research component, as a number of impacts are associated with dam construction which took place in the early seventies. The assessment also accounts for inevitable project actions which will not be subject to further choice on behalf of the project proponent. These include the initial increase in the level of the dam to full supply. The infrastructure necessary for this component of the scheme is already in place and the decision has been finalised on behalf of the Department of Water Affairs. A second inevitability will comprise the need to reduce water in the dam to dead stock if the supply from the Cunene River in Angola is jeopardized. In the interim three alternatives strategies for dam management are identified.

Alternative 1 entails management of the dam as a semi-static reservoir compensating only for water lost to evaporation or released via the southern wall outlet.

Alternative 2 advocates that the dam be used for buffer storage of the supply from the Cunene River. At present, only excess water, which is not fed into canal and pipeline components of the distribution network, accumulates in the Olushandja Dam. Buffer storage would require that all water from Calueque is transferred directly into the dam from where it is pumped into the different components of the distribution network.

Alternative 3 is a blow down strategy requiring that the dam be drawn down to approximately half of its capacity every few years depending on results of monitoring of water conductivity and total oxygen demand.

The way in which the dam is managed will directly or indirectly affect the identified social assessment variables. Mitigation measures are incorporated, as far as possible, into the recommended management plan. Additional mitigation is aimed at compensating for negative impacts by providing substitute facilities, resources and opportunities. It is recommended that a combination of *alternatives 2 & 3* comprise a strategy for dam management. This entails that dam is utilised for buffer storage of all the water transferred from the Cunene River. Intermittent draw downs are incorporated into the buffer storage management plan to mitigate against the build up of salinity levels, facilitate the removal of plants invested with disease carrying organisms and create favourable conditions for fish production.

Extension programs should be introduced aimed at heightening people's understanding of the health implications of raw water consumption, and educating people in the use of simple filtering devices. It is further recommended that additional studies are commissioned to investigate possibilities for relocation and compensating households for loss of land. Agricultural potential of the area around the dam should also be subject to further investigation prior to facilitating the implementation of small scale drip irrigation schemes.

To increase the value of the Olushandja SIA as a case study with lessons for future SIA undertakings in developing countries, it is important that the process of interaction associated with a political approach to SIA initiated by the present study, become a feature of the implementation, operational and monitoring phases of the upgrading scheme. In this way the SIA of the Olushandja Dam can set an important precedent for future developments with social implications not only in Owambo, but in other developing contexts.

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1 INTRODUCTION

The Olushandja Dam is situated in far northern Namibia in the area traditionally known as Owamboland (Fig. 1). The dam is technically a reservoir that forms an important component of a pump storage scheme that operates in conjunction with the Calueque Dam situated across the border in Angola, 20km from the Olushandja Dam. The transfer scheme, initiated in 1970, was designed to supply the relatively densely populated north-central portion of former Owamboland with water from the Cunene River. This watercourse designates part of the international border between Namibia and Angola.

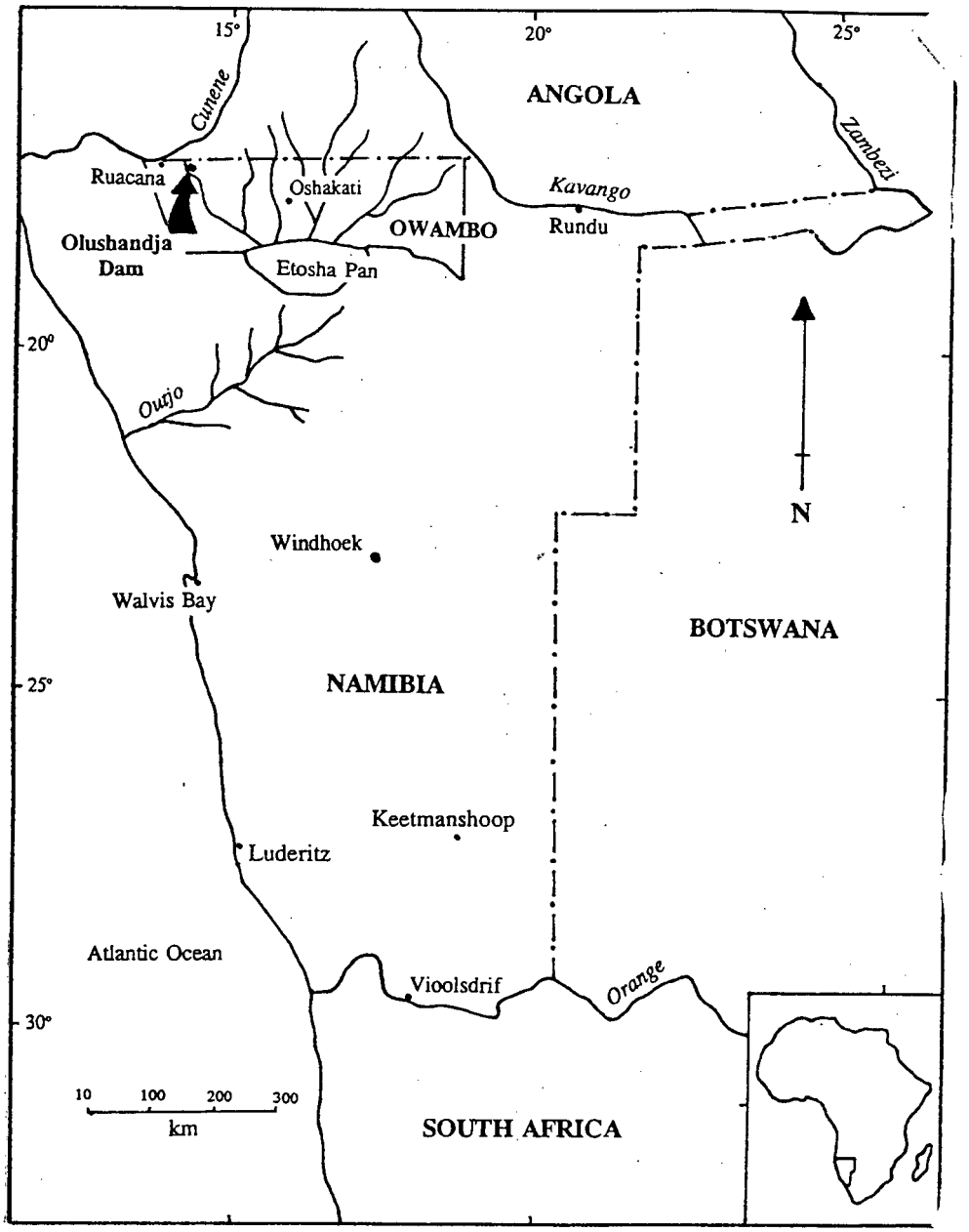


Figure 1: Location Map

Subsequent to the construction of Olushandja reservoir, the completion of Calueque Dam and the transfer of water into Namibia has been repeatedly prohibited or interrupted by the outbreak of hostilities on both sides of the border. Fifteen years after the initial agreement with Angola, internal conflict in Namibia has given way to peace and stability and international relations between Angola and Namibia have improved considerably. With national concern focused on development as opposed defence and security, provision can now be made to maximise the efficiency of water transfer into and from the Olushandja reservoir.

Water shortage in Owambo is regarded as the major factor limiting development (Marsh and Seely, 1992). The water transfer scheme from the Cunene River is aimed at facilitating development by guaranteeing a surety of water supply via a bulk water supply distribution network, comprising canals and pipelines, to towns and rural communities in central Owambo. The project entails infrastructural upgrading of facilities originally designed and partially constructed in the early 1970s. The upgrading scheme is under the auspices of the Namibian Department of Water Affairs. An environmental assessment of the Olushandja Dam component of the upgrading scheme is being financed with external aid from the Dutch government. The evaluation of the social implications will focus on the negative and positive impacts of the project on surrounding rural communities. The context and nature of the project is illustrative of a number of limitations which characterise the undertaking of impact assessments in developing countries. The following discussion of the social effects of the upgrading of the Olushandja Dam will concentrate on the elucidation and clarification of the problems generally associated with social impact assessment (SIA) in developing countries.

The dissertation comprises 7 chapters. The first of these explores the current status of SIA in developing countries and the implications of government dependence on foreign aid to finance development initiatives.

Chapter 2 examines the specific case of the Olushandja Dam, provides background to the need for the water supply project, lists the principle beneficiaries of the supply scheme, and describes the infrastructural requirements on the Namibian side of the border. The legal, administrative and policy requirements relevant to the SIA undertaking are also investigated.

Chapter 3 explores the relationship between environmental impact assessment (EIA), SIA and Integrated Environmental Management (IEM) as an approach adapted to developing circumstances. The chapter includes a critical comparison of qualitative versus quantitative techniques for data collection and analysis for SIA in developing countries.

Chapter 4 reviews the methods used for data collection and their suitability to developing environments. The most important of these methods are aimed at involving the community as participants in the decision-making process and are evaluated as such.

The fifth chapter is more specific to the Olushandja Dam project and takes a look a the affected human environment from a socio-historical perspective, focusing on the cultural development of rural Owambo communities. This section emphasises the important relationship between people and their biophysical surroundings. Such relationships are common to rural environments in developing countries.

Chapter 6 is technically orientated with the objective of fulfilling the terms of reference outlined by the project proponent (Department of Water Affairs, Namibia). The primary, secondary and regional social implications of the project are discussed from both an evaluative and predictive perspective. Three economically feasible water management alternatives are identified. These are compared using a suitable qualitative framework technique. Finally, a number of appropriate mitigation options are identified and suggestions made for a cost-effective monitoring program. The dissertation ends with a recommendation regarding the most appropriate approach to dam management to achieve a balance between technical or engineering feasibility, and minimising negative social impact.

The dissertation should be read in conjunction with the baseline information report compiled by members of a project team from the M.Phil program of the Department of Environmental and Geographical Science (listed in Appendix 2). The baseline document provides detailed geographic information about the study area and a comprehensive summary of the results of the social survey.

1.1 SIA and water impoundment projects in developing countries

Environmental policies and environmental impact legislation in most western, industrialised countries can be traced back to the National Environmental Policy Act enacted in the United States in 1969. A series of court decisions arising from NEPA, mandated the inclusion of *social effects analysis* as part of the Environmental Impacts Statements (EIS) required by NEPA legislation. Hence the introduction of a social science component in environmental impact assessments (EIAs). This component has subsequently developed as a discipline in its own right known as social impact assessment or SIA.

Since the adoption of EIA as a planning tool by various developed countries, numerous international organisations have incorporated EIA into the process of funding and implementation of so-called development projects in African and Asian countries (Horberry, 1985). In requesting EIA's as pre-requisites for project funding, international donor organisations are simultaneously requiring that social impact assessments (SIA's) be undertaken before project approval may be granted. In this context SIA is inextricably linked to the current concept of sustainable development.

This concept of sustainability focuses on achieving economic growth, aimed at improved living standards without compromising the ability of future generations to exploit the same resources. Part of the function of an impact assessment should be to ensure that a particular development project fulfils the requirement of sustainability. The World Commission defines sustainable development in terms of meeting the needs of both present and future generations (World Commission of Environment and Development, 1987).

These "needs" are regarded by the commission as the "essential needs of the world's poor, to which overriding priority should be given." (Rees, 1988, pp 273). SIA plays a crucial role in this regard as it aims to influence development planners, modify development processes and achieve greater social benefit from development (Henry, 1990). Rickson *et al*, 1990a see SIA as part of a general learning process that is fundamental to sustainable development.

Increasing emphasis is being placed on the need for environmental impact assessments (EIA's) in relation to water resources projects in developing countries. In Africa forty dams were under construction at the start of 1994 (IWCDM, 1994). Most of these projects receive technical and financial assistance from international organisations and donor agencies. In many of these cases, proposals for impoundments are initiated by the promise of external aid. In the past assessments for such projects were confined to the consideration of financial and engineering feasibility resulting in a number of projects having unexpected negative social, biophysical and health consequences (Giroult, 1983 in Burdge, 1990). The most celebrated cases were those involving the construction of dams and hydro-electric schemes in Africa (Freudenburg 1986, ICOLD, 1992; Bisset, 1984, Canter and Canty, 1985). SIA, as a means to anticipate and mitigate adverse impacts of such development projects on affected communities, has since become widely accepted as an integral part of the planning process.

EIA's in relation to dam projects appeal to international agencies for several reasons. Among these is the fact that economic growth in the past has largely been related to the availability and distribution of water (Barbour and Larsen, 1994). Consequently, dams are regarded as essential for the development of third world countries, particularly in Africa and Asia. Donor countries are often intent on promoting scientific and technological development without losing sight of the need for environmental protection. The initial funding of an environmental impact assessment is marginal by comparison to the cost of the completion of a large dam construction project. The EIA consequently has a dual purpose in promoting development and reflecting favourably on the donor country or organisation with their own programs to promote, funds to disburse and constituencies to satisfy (Wandesforde-Smith *et al*, 1985). EIA activities are thus good opportunities to spend money and satisfy domestic interests. As Horberry (1985) points out, the nature and extent of the influence donors have on EIA in developing countries is shaped as much by the interests and organisational characteristics of the donors as by the needs and priorities of the recipients.

In their motivation for the development of water supply projects, it is tempting for the governments agencies or project proponents in developing countries to highlight macro economic and social benefits while paying less attention to local impacts. Barbour and Larsen (1994) draw attention to the fact that the demand created by the majority of mainly urban water consumers, often imposes a negative externality on the affected rural community. In some projects in developing countries even the most important localised social consequences, such as that of resettlement, have not, in the past, been accorded the significance due to them (ICOLD, 1992).

The extent to which local settlements are going to bear the costs to serve national interests must be given consideration, particularly as these are often the poorer and most disempowered communities and individuals. According to the Interorganisational Committee on Guidelines and Principles for SIA (1994), just as the biophysical component of an EIA tends to focus on threatened or endangered plant and wildlife species, the social component should devote particular attention to vulnerable or sensitive segments of the human population. No category of persons - particularly those that might be considered more sensitive or vulnerable as a result of age, gender, ethnicity, race, occupation or other factors - should have to bear the brunt of adverse social impacts. Rabel and Burdge (1969) maintain that social consequences of development always occur and can be measured and are borne at the community and local level. Projects are, nevertheless, justified and sold on the basis of regional and national economic goals. The danger exists that the "buyers" of these projects - international donor organisations - regard populations of developing countries as a single entity in need of technological and financial support. In reality there are large discrepancies between different sectors of developing populations and the purported national benefit may be serving a relatively small elite at the expense of those communities entirely dependent on the environment affected by the development project.

In many African countries comprising a variety of often marginalised social groups, limited exposure to and involvement in democratic political processes on behalf of decision-makers and project proponents, makes the introduction of SIA with its ideas of community preservation and participation particularly challenging. Fuggle and Rabie (1992) believe that the integration of environmental concerns into public policy depends on an open system of government, a wide disclosure of information and an informed citizenry. Recently independent countries like Namibia have historically lacked these elements of government. This poses a serious limitation to the implementation of social assessments, the success of which may depend on community involvement and participation.

EIAs may be further complicated by fundamental differences in perspectives between rural communities, government agencies and international groups responsible for developing SIA procedures regarding issues that affect development. These include differences in definition of "wild" resources and their "use" value as well as ethical, cultural and institutional differences (Murphree, 1995). As a result the relationship between people and the environment is often intricate and it becomes difficult to distinguish between social and biophysical impacts. In order to make a significant contribution to development, analysis of often unfamiliar traditional, religious, political, family and economic values must be the central focus of SIA in developing countries. In this regard, Derman and Whiteford (1985) criticise the lack of historical perception found in theory and method of SIAs, as a means of explaining current social conditions, beliefs and attitudes. Ross (1990) maintains that it is ultimately the nature of human experience that makes an occurrence an impact, and shapes the way a community responds.

Consequently, the implementation of SIA in developing countries cannot merely involve the transfer of methodologies developed in industrialised countries as these are generally incompatible with both social and political structures and processes in developing countries. Much of the literature regarding social

impact assessment argues against the automatic implementation of SIA in developing contexts (Ip, 1990; Rickson *et al*, 1990a; Derman and Whiteford, 1985; Henry, 1990; Brown, 1990). Henry (1990) emphasises the need for SIA to confront the structural problems surrounding development in addition to measuring and monitoring social consequences. Furthermore he maintains that "development is a political process and in that process decision-making rationality is derived primarily from considerations of political power and not from social data produced from SIA studies"(Henry, 1990, pp.100).

Development projects in the third world is defined by Finsterbusch (1985) as a sub-field of SIA that addresses developing conditions, the politics of joint sponsorship by the development agency and recipient country, and the economic and social criterias of the development agency. What distinguishes this sub-field is its "foreign settings" for projects and some "unique traditions" which Finsterbusch does not specify. This would appear to be an oversimplification of the adaptations required to implement SIA in developing countries and underestimation of the inherent structural problems surrounding development. It must also be realised that the differences between social structures and value systems between developing countries are significant, more so than between developed nations. And yet there is a tendency in the literature to group developing societies together as experiencing the same problems which is sometimes but not always the case.

In addition to the fundamental differences in perception of development, there are a number of practical limitations to the efficient implementation of SIA that may be common to developing countries. These include an insufficient amount and questionable reliability of baseline information, which is often disseminated between government agencies and departments. It may be difficult to determine the timing and stage of the planning and design process of a project when an assessment is commissioned and whether there remain opportunities for project modification (Brown, 1990). More seriously, the conducting of SIA's may take place after projects have been approved (Kakonge and Imevbore, 1993) and even after construction has begun or the project has been completed (Chonguica and Stromquist, 1992). It is in these cases that SIA is used to try and justify or legitimise decisions already made.

Often few of the legal and administrative frameworks have been created in developing countries to define the responsibilities of various governmental departments in the environmental and social assessment processes (Burdge, 1990). This is particularly true of African countries still trying to break away from colonial dependency and develop autonomous legal and administrative policies and institutions. A further constraint may be that the various parties involved in an SIA differ in language, history and culture and may consequently have a different perception of change and development. What researchers may regard as legitimate or "right" may not coincide with what is important and desirable for affected individuals and communities. The perceptual gap may become particularly wide when SIA practitioners are recruited from other countries and continents which is often the case when a project is funded by a donor agency. A considerable degree of perceptual error will inevitably arise at some level of communication between donor agencies, social assessment practitioners, local government authorities and affected communities.

In addition to the above-mentioned constraints, a number of practical and ethical issues arise regarding techniques and methodologies used to evaluate social impacts of development projects. With regard to dam construction, economic benefits can be assessed using quantitative and monetary evaluations, but for many types of social impacts such evaluations are inappropriate (ICOLD, 1992). Although policy makers and planners appreciate the simplicity of numbers, the ethics of communicating results based on input from affected communities in a manner which such communities cannot understand or appreciate, must be carefully considered. If communities are to play a constructive role in accelerating and sustaining development, they need development information in a form they can understand directed through channels they are accustomed t. A wealth of information and literature exists regarding the merits of quantitative versus qualitative and technocratic versus political approaches to SIA. Whatever methods are used, it is crucial for policy makers to realize that SIA may assist or influence the decision-making process but cannot necessarily provide the ultimate solution to problems associated with development projects.

Since most national governments and international donor agencies accept SIA as necessary, the successful implementation of SIA can be assisted greatly by the range of literature that has become available concerning attempts to implement SIA under various conditions. Case studies for construction facilities such as dams can act as an important basis for prediction when circumstances are similar (Finsterbusch, 1985).

Most south-east Asian countries have formal EIA policies and have accumulated experience in carrying out EIA's and SIA's to inform decisions about the design and implementation of development programs and projects (Horberry, 1990; Brown, 1990). Similarly detailed accounts are available concerning experience with SIA and the Aboriginal people of Australia (Ross, 1990), the Maoris in New Zealand (Nottingham, 1990), and rural communities in South America, particularly Brazil (Wandesforde-Smith *et al*, 1985). Well known case studies are also available based on experiences in Mexico (Dewey, 1985; Corbett, 1985), China (Ip, 1990) and northern Canada - the much publicised Mackenzie Valley Pipeline Case giving rise to the Berger Inquiry which is generally judge as the key successful example of social impact analysis (Derman and Whiteford, 1985).

By contrast few case studies from African countries south of the Sahara have been published. There are noticeable exceptions from Kenya, Lesotho and Mozambique (Hunt, 1995). According to Kakonge and Imevbore (1993) the application of EIA's has been limited in Africa as few countries have formal environmental policies or extensive experience in incorporating environmental, including social factors, into decisions. It is consequently difficult to find precedents to guide choices in methodology and approaches to SIA in an African or southern African context. Many, if not most SIA's in Africa are a response to specific procedures required and defined by donor countries and funding institutions.

1.2 Study Objectives

The Olushandja Dam in northern Namibia forms part of internationally funded water resource development project. The envisaged upgrading of the dam entails significant fluctuations in the water level which will hold significant implications for the traditional rural communities living adjacent to, and dependent on the dam as an important source of water. An impact assessment has been commissioned by the project proponents, the Namibian Department of Water Affairs (DWA), to assess social impacts of the proposed upgrading scheme. The context of the SIA is indicative of many of the characteristic constraints, problems and challenges in developing countries mentioned above.

In addition to fulfilling the Terms of Reference specified by the client, this study aims to use the Olushandja Dam SIA to demonstrate some of the advantages and limitations that may be common to the implementation of SIA in other parts of southern Africa. The study will consequently focus on those aspects of the SIA that reflect southern African conditions and may have relevance to future social assessments undertaken in southern Africa as well as developing countries in other parts of the world.

The principal objectives of the case study are:

- To investigate the administrative and legislative requirements and constraints associated with the commissioning of an SIA for the upgrading the Olushandja Dam.
- To examine the findings of a social survey and assessment of rural communities resident in the vicinity of the Olushandja Dam.
- To evaluate the methods employed in data collection and conducting the social study, their strengths and limitations in a developing context.
- To use a narrative and qualitative approach in the prediction of positive of negative social effects of the proposed upgrading scheme.
- To identify and evaluate any remedial measures that may be required to mitigate negative impacts of the upgrading scheme and suggest ways of enhancing positive effects and opportunities.
- To make recommendations for a simple and cost-effective monitoring program.

The undertaking of the Olushandja Dam social assessment was subject to a number of specific assumptions and limitations related largely to logistical aspects of the study. These are detailed in the baseline report compiled by the UCT social assessment team. In the present study references to the broader set of limitations and assumptions associated with SIA in developing countries are incorporated in discussion of numerous aspects of case study throughout the text.

1.3 The Olushandja Dam upgrading scheme

1.3.1 Background to the project

Namibia is the driest country in sub-Saharan Africa, with an average annual rainfall of 250mm. Located in the western part of southern Africa, it is characteristic of a semi-arid environment, subject to highly variable rainfall and severe droughts, of which the social and environmental effects often last for decades (Marsh and Seely, 1992). Water is consequently an exceptionally valuable resource.

By contrast to the rest of Namibia, the northern parts of the country comprising former Owamboland experience relatively high rainfall decreasing westwards from approximately 550mm to 350mm per annum (Fig. 2). On average 70% of this rain falls during late summer between January and March (Department of Water Affairs, 1990). It is supplemented by surface water, originating on the southern Angolan watershed between the upper courses of the Cunene and Okavango rivers. This supply is concentrated during the wet season in numerous shallow watercourses known as *oshanas*. An *efundja*, or major flood occurs intermittently - on average once every 3 years. The *efundja*, essential for groundwater recharge and vegetation renewal, flows southwards draining into the Etosha Pan via Lake Oponono.

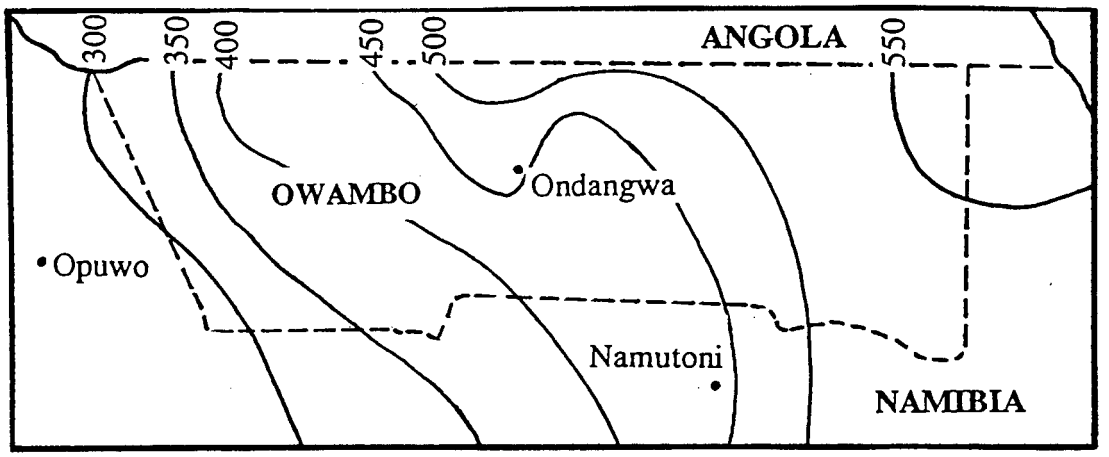


Figure 2: Mean rainfall isohyets across Owambo

Owing largely to the seasonal availability of water, this north-central region of Namibia supports approximately 44% of the national population (615 057 people, according to the 1991 census).
The most active *oshana* in the region, namely the Cuvelai, is situated in the central portion of former Owamboland, known as the Cuvelai Basin, which covers an area of approximately 10 000m^2. The basin occupies a broad plain of low relief, averaging approximately 100m - 1100m above sea level with an

average gradient of 1:3000. Mean monthly diurnal temperatures for the region range from 26.1° in December to 17.5° in July. Mean monthly values for humidity range from 50% in March to 17% in September. Under these ambient conditions, annual potential evaporation exceeds mean annual rainfall throughout Owambo (Department of Water Affairs, 1992).

The Cuvelai Basin is the most densely populated part of northern Namibia, home to over 400 000 people with a density of 100 people per km^2 compared to an average population density of 2 per km^2 for Namibia as a whole (McIntyre and Atkins, 1994). Owing to a combination of high population pressure, infertile soils, high evaporation losses and frequent drought, water is still the single most important limiting factor to industrial and agricultural development even in the *oshana* region. The systematic development of water supply infrastructure is consequently the focus of government attention in this area (Marsh and Seely, 1992). In the past (prior to 1970) attempts have been made to concentrate and intercept the annual run-off using a system of shallow earth dams (Stengel dams), storage culverts and earth-lined canals. Such projects are described in the Master Water Plan of 1968 (Department of Water Affairs, 1968). Although these were initially successful in providing a permanent supply of water, the storage structures were poorly maintained, water quality deteriorated rapidly during the dry season and dams and channels eventually silted up.

Despite a slight decrease in the population growth rate in recent years, the aspirations and social advancement of the Owambo people, particularly since Namibian independence in 1991, have changed such that the demand for water and proper development planning has increased dramatically. Studies undertaken by the Department of Water Affairs indicated that water consumption can be expected to increase between 3% and 7% per annum between 1990 and 2020 (Lund, 1992).

The Cunene River is one of relatively few perennial rivers in southern Africa. It is 1 050km long and has a catchment area of 106 500km^2, of which 13% is in Namibia (Bethune, 1995). The importance of the Cunene River as a major water source was acknowledged in the 17th century by the first Border Agreement of 1886 between the governments of Germany and Portugal.. A second agreement was signed by in 1926 by the Union of South Africa who were assigned by the League of Nations to administer South West Africa as a "trust territory" (McIntyre and Atkins, 1994). According to one of the articles of the agreement, a part of the international border between South West Africa and Angola was defined as the middle of the Cunene River, from the Atlantic Ocean to the Ruacana Falls. In terms of this definition the international status of the Cunene River and the right of both countries to use water from the river was recognised (Department of Water Affairs, 1992).

In response to the escalating demand for a permanent source of water in north-central Namibia, an agreement with the Portuguese government in Angola was signed in 1969, entitling Namibia to pump 6m^3/s from the Cunene River. This supply would be extracted from the Cunene River at the Calueque Dam in Angola, upstream of the point where the river designates the international boundary. The dam was originally designed to regulate the weekly flow of the Cunene to optimise power generation at the

Ruacana Falls Hydroelectric Scheme, 30km downstream at the point where the river begins to designate the international border between Namibia and Angola. Figure 3 illustrates the main features of the transfer scheme.

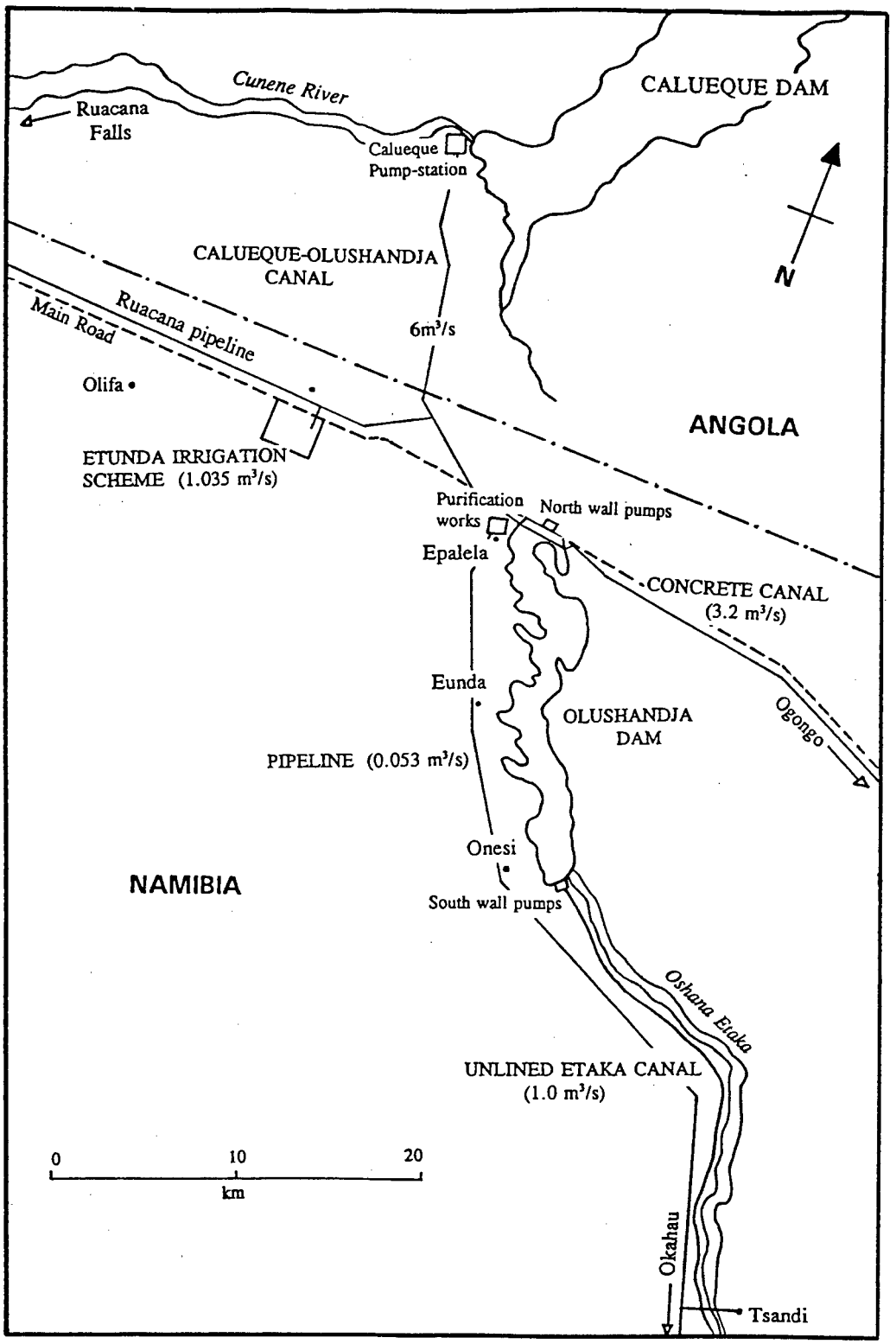


Figure 3: Main features of the Calueque-Olushandja transfer scheme.

Subsequent to the negotiation of the agreement, two canals namely the Oshakati and Etaka canals were constructed, as well as a pipeline system to distribute water from the Cunene to the various population centres in Owambo (Fig. 4). The Olushandja Dam, situated on the western boundary of the Cuvelai Drainage Basin, was built to act as a balancing and storage dam for water transferred across the border via a 21km concrete lined canal, closer to Namibian consumers. Water would then channelled into the canals and pipelines leading to settlements to the south and east of the Olushandja Dam.

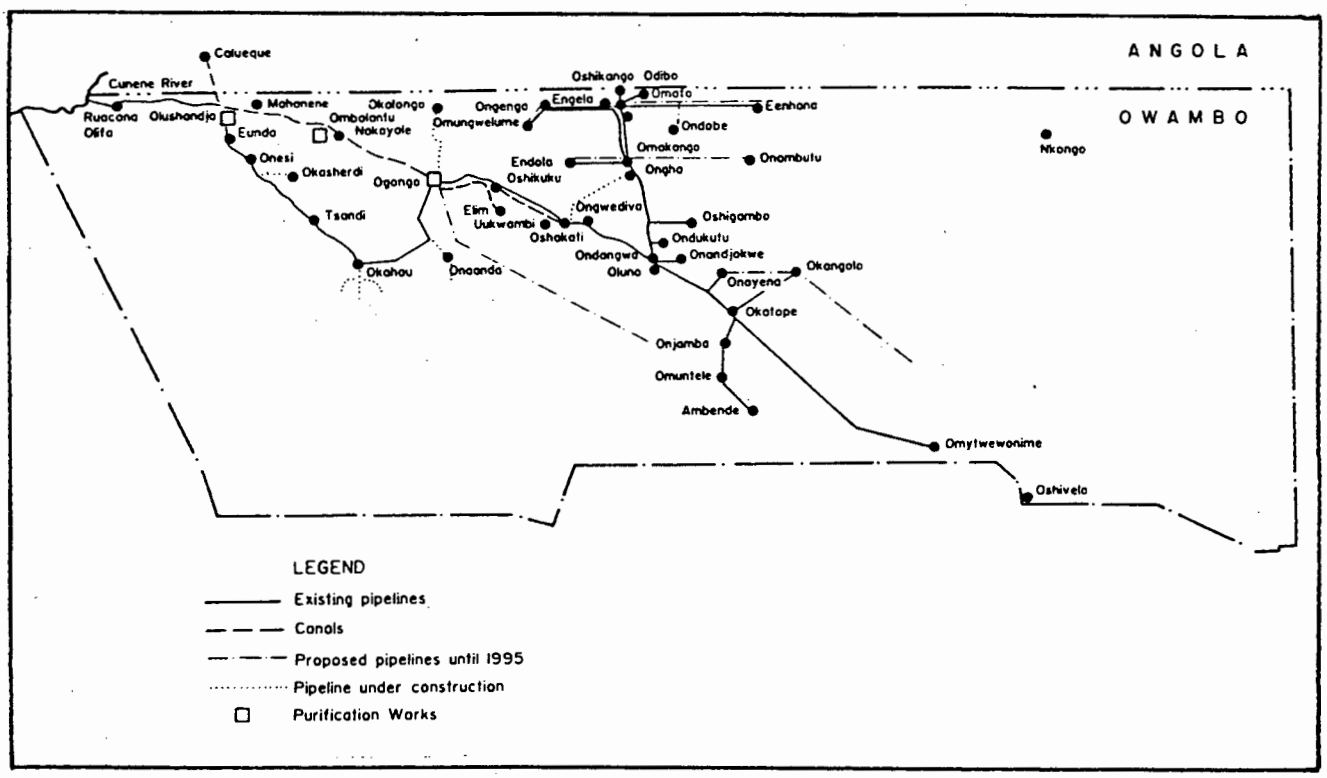


Figure 4: Existing and proposed pipeline and canals (Source: Marsh and Seely, 1992)

1.3.2 Existing Infrastructure

The Olushandja Dam is situated in the course of the Oshana Etaka and has a northern and southern wall. Consequently minimal excavation took place at the time of construction and the dam has a maximum depth of only 3m. The dam is not situated in a catchment area and there is no significant run-off into the dam. A high surface area to volume ratio results in evaporation losses of up to 2.2m a year (Lund, 1992).. Ideally the surface area of the dam should be reduced, but reconstruction costs are prohibitive

Although the construction of the Olushandja Dam was complete by 1975, the outbreak of hostilities in Angola disrupted pumping from the Calueque Dam. The transfer operation thus ceased until early 1990.

In the interim, provision was made to supply water to Owambo communities via a pipeline from the Ruacana Falls Dam. The efficiency of this system is hampered by the rugged terrain between Ruacana and the north-central plateau with the difference in elevation of 480m from the base of the falls. Consequently pumping costs are in excess of 10c/m^3 at a rate of 0.6m^3/s in comparison to a cost of 1c/m^3 at a rate of 3.5m^3/s possible from Calueque (Department of Water Affairs, 1992).

The fluctuating security situation in Angola necessitated the replacement of the original Calueque pump-sets in Angola with a smaller set capable of 1.5m^3/s per duty pump (Lund, 1992). Early in 1996, the capacity of the pump-sets will be increased to 3m^3/s each, allowing for the maximum abstraction rate of 6m^3/s sanctioned by the 1969 agreement. At present the northern embankment of Calueque Dam is only partially complete and suffered considerable damage during the war. Water thus has to be diverted to the pump station via an approach channel on the south bank of the Cunene River. This system will remain in operation indefinitely.

On the Namibian side of the border, water has been impounded in the Olushandja Dam since 1975. The reservoir, 18km in length and on average 300m wide, currently operates at approximately 30% of its full capacity (42.3 x 10^6m^3) (Haussler, pers. comm., 1995). Water is syphoned into the Oshakati canal through an inverted syphon under the dam parallel to the northern embankment. This supply is supplemented by water pumped directly from the dam. The pump station is situated on the north wall of the dam. It suffered serious damage during the border war and has subsequently undergone considerable repair work. Two 1.6m^3/s pumps have been installed, their combined capacity being that of the Olushandja-Ogongo canal (3.2m^3/s). A complete set of spare pumps will be provided for 100% surety of supply along the canal.

The Etaka canal begins at the southern embankment of the dam. Pumping of water into the canal is required when the level of the dam falls below that of the canal (i.e. below 35% of maximum capacity). The outlet works comprise two electrically driven pumps which operate at 350 - 400l/s, depending on the level of the dam (Haussler, 1995). There is also a gated outlet structure through which water can be fed into the Oshana Etaka or into the canal using a diversion wall. The Etaka canal follows the course of the original Oshana Etaka. It is unlined and has a capacity of 1m^3/s.

There is a purification works at the western edge of the northern embankment. Water is abstracted from the Calueque-Olushandja canal at a rate of 100m^3/h, purified and piped via Eunda and Onesi to Tsandi and further south to Okahao. There is a second purification works at Ogongo from where potable water is further distributed to Oshakati and settlements along the way. Take-off points are regularly spaced along the length of the pipelines to serve rural communities between settlements. Water from the pipelines is also used to supply livestock watering points (Irving *et al*, 1993).

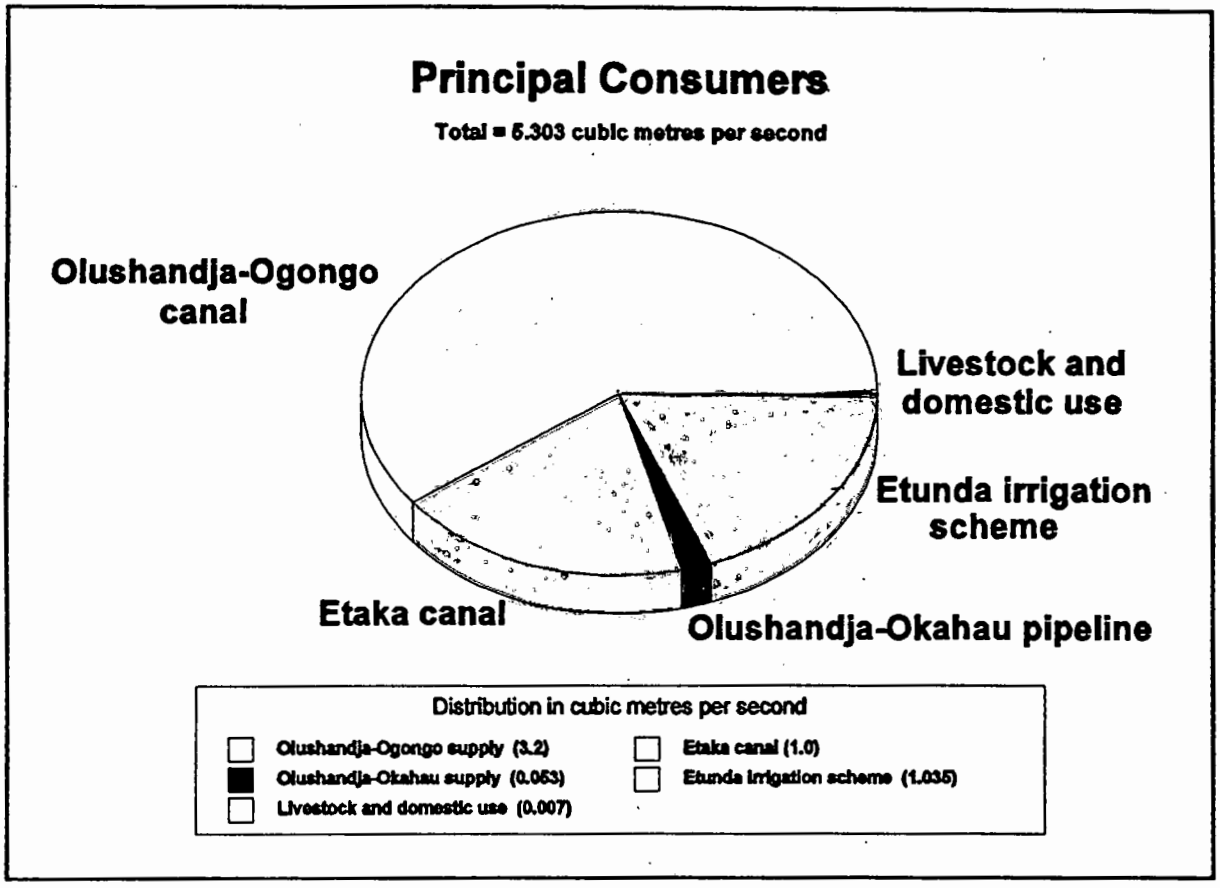


Figure 5: Principal consumers of water extracted from the Cunene River

1.3.3 Principal Consumers

In 1994 it was estimated that 70% of the population in northern Namibia rely on water from the Cunene River, while the remaining 30% tap groundwater supplies using boreholes and hand-dug wells (Ward, 1994). The principal consumers of water stored in the Olushandja Dam include those communities dependent on the canal and pipeline network as well as those people living adjacent to the dam itself. The estimated average proportional distribution of the $6m^3/s$ to be transferred from the Cunene River is summarised in Figure 5. A significant proportion of water will be lost from the Calueque-Olushandja canal and the from the Olushandja dam through evaporation (Lund, 1992).

The Olushandja-Ogongo-Oshakati Supply Scheme

The Olushandja-Ogongo canal is concrete lined, 90km long and has a design capacity of $3.2m^3/s$. It makes provision for a supply of raw water for domestic and livestock use between Olushandja Dam and Ogongo, the most important concentrated settlement *en* route being Ombalantu with an estimated

population of over 2000. Ogongo has a population of approximately 3000 (based on the 1991 census data) and there are numerous scattered settlements along the route of the canal. Water retention in the canal is determined by the demand at Ogongo which is approximately 1000m³/h (Haussler, 1995). Rural populations on either side of the canal utilise this raw water for domestic purposes despite the absence of a suitable means of access and extraction.

Water is chemically treated at Ogongo. This plant has capacity to treat approximately 0.8m³/s. Purified water is piped from Ogongo to Oshakati-Ongwediva, the largest urban area with a combined population of approximately 65 000. At Ondangwa the pipeline branches off to the north, into a herringbone network that extends to just below the border serving numerous small settlements, and to the south-east as far as Oshivelo (Lund, 1992). At the main towns and settlements, water is pumped into a elevated tank or distribution reservoir. The entire canal-pipeline system is over 700km long. There are an estimated 180 take-off points to serve rural populations along the line and numerous circular basins for the watering of animals. Many of the standpipes are, however, damaged and inoperational (UNICEF, 1990).

The Etaka Canal

The unlined Etaka Canal, with a capacity of 1m³/s starts near Onesi and ends at a point southeast of Okahau. Water in the canal is used by people and livestock that live along the route of the canal. The estimated demand is approximately 10 000m³/ day (Haussler, 1995). The canal was originally designed to serve the rapidly growing concentrated settlement of Tsandi which in 1990 had an estimated population of 1500 and has expanded considerably since. As a consequence an additional supply is piped to Tsandi and further south to Okahau.

The Olushandja-Okahau Supply Scheme

The scheme comprises a pipeline with regularly spaced taps and watering points for domestic and livestock use. As previously mentioned, potable water is pumped from the purification works at the north wall Olushandja Dam via Eunda, Onesi and Tsandi to Okahau. The design capacity of the scheme is 3800m³/day (Lund, 1992). The Olushandja-Eunda section has a slightly larger diameter than the rest of the pipeline. The population of Eunda is conservatively estimated at 2 144 (Vikundje, 1995) and that of Onesi, 1 000 in 1990 (BICON/LCE, 1992). There are numerous scattered dwellings along the route of the pipeline.

Northwestern Owambo Irrigation Scheme (Etunda)

The Northwestern Owambo Irrigation Scheme is a pilot irrigation project under the auspices of the Ministry of Agriculture, Water and Rural Development. It was developed in response to a directive from the President of the Republic of Namibia (FNDC, 1991). The pilot scheme is 160ha in extent and located at Etunda 15km west of the Olushandja Dam, where the soils are marginally more fertile than those of the

Cuvelai drainage basin. The area under irrigation will eventually be extended to 1 500ha. The primary aims of the pilot project are to allow for the resettlement of the post-war returnees and landless farmers, and to encourage commercial farming. 50 farmers and their families will be the initial beneficiaries of the project.

At present water for the scheme is pumped from the Calueque-Olushandja canal via the Ruacana-Olushandja emergency pipeline, the maximum abstraction rate being 1200m^3/hour The construction of an additional canal leading from the Calueque-Olushandja canal to Etunda is being considered, but the feasibility study has not yet been undertaken.

Future demand by the scheme will depend on the type of crop cultivated, soil moisture retention characteristics and the time of year. It is estimated that irrigation of 160ha will require 2.9 million m^3/annum with a peak demand of 2 100m^3/hour for a 10 hour day (Department of Water Affairs, 1991). An additional 60m^3/day will be required for household consumption. Approximately 1.035m^3/s of the proposed 6m^3/s to be transferred from Calueque will be utilised by the pilot irrigation project (Lund, 1992). If the scheme is extended to 1500ha its water requirements will be in excess of 2.5m^3/s. The total development is likely to benefit 2 000 people directly with indirect benefits for the families of labourers and participants. At best the scheme will benefit 0.03% of the total population of north-central Namibia.

Communities adjacent to the dam

The average population density in the area adjacent to the dam varies between 10 and 50 people per km^2. Apart from those who depend on groundwater supplies, most of the inhabitants within the Omusati region are indirectly dependent on the dam in the dry season, through the use of the Etaka canal, the Olushandja-Ogongo canal or Olushandja-Okahau pipeline. A number of households (between 600 and 700) use the dam directly for consumptive, cooking and washing purposes. The dam is also a source of fish and frogs, and provides water for livestock - cattle, goats and donkeys.

There is a small concentrated settlement approximately 0.5km from the northern wall of the dam called Epalela. People began to settle at Epalela during the war when there was an army base establishment set up at the north wall of the dam. The settlement is largely a trade centre with a few permanent inhabitants, most of whom are fishermen. It has become an important cattle market in the region. Unlike the inhabitants of the nearby towns of Onesi and Eunda, who have access to the Olushandja-Okahau pipeline, Epalela residents are directly dependent on the dam.

1.4 The Project Proposal

There are evidently two reasons for the upgrading of the Olushandja Dam:

1. The 1969 agreement between Angola and Namibia was ratified in 1990.
2. The Namibian government would like to guarantee a surety of supply on the Namibian side of the border to those people who depend on the Cunene River, and consequently on the Olushandja Dam, as their only source of water during the dry season

To fulfill the requirement of 100% surety of water supply, $6m^3/s$ will be pumped by the Calueque pump-station without interruption and all excess water discharged into the Olushandja Dam. If there is an interruption in the transfer of water from Angola, there should be a dependable supply from Olushandja Dam for a period of two months (Hydroconsults, 1970).

No significant construction activity will take place at the dam. The upgrading works entail the provision of pumping facilities at the north wall of the dam and the improvement of existing facilities at the south wall. These operations were underway at the time of commissioning of the EIA.

The impact of the project will be in terms of water management as opposed to the development of infrastructure. With an increase in the supply from Calueque, the level of the dam will rise to that of full supply, but should the transfer of water be jeopardized the dam may have to be drawn down to dead storage level (5% of capacity) (Haussler, 1995)

1.5 Terms of Reference

The Terms of Reference for the Social Impact Assessment were compiled by the Department of Water Affairs in collaboration with the Social Assessment team from the University of Cape Town (refer to Appendix 2).

The Department of Water Affairs requires an identification, investigation and evaluation of the effects of the proposed upgrading of the Olushandja Dam on the surrounding social environment. Upgrading will involve a considerable rise in the level of the dam as the volume of stored water increases from 12.69 x 10^6m^3 to 42.29 x 10^6m^3. This will have a number of implications for the communities that live in the vicinity of the dam. The geographic extent of the potentially affected environment has been defined by the social assessment team as the area within a 10km radius to the east, west and south of the dam and as far as the Angolan border in the north. The delimitation of the study area was based on a number of considerations discussed in the baseline report.

The scope of the study has been outlined by the project proponents as follows. A brief account is given as to how each component of the terms of reference was addressed by the study team.

- A comparison of the existing social groups or communities that have gradients of availability or access to water from the Olushandja Dam and other water supply infrastructure. This should include, as far as possible, an evaluation of how water provision has influenced the social environment which may involve an investigation of changes in lifestyle and natural resource utilisation over time.

  A comparative evaluation was undertaken by dividing the study area into three zones that could be indicative of the changes in dependency on the dam and other water infrastructure. The influence of water provision on people's lifestyles was determined through discussion with community members who recalled what conditions were like prior to dam construction.

- Predictions of the positive and negative socio-economic effects of the proposed water supply upgrading project in both the long and short term. Various scenarios should be developed and opportunities, impact and resource replacements identified. The impacts should also be considered in a regional and national context.

  Predictions of positive and negative effects are based on information provided by household interviews and community workshops. Various predictable and inevitable occurrences are identified, and three alternative water management strategies discussed on the basis of input from the affected public and specialist consultation.

- Identification and evaluation of any remedial measures which may be required and recommendations for a simple and cost-effective monitoring program.

  A number of remedial measures are identified for each option also based largely on public response to interviews and workshops conducted in the study area. These responses form the basis for the recommended monitoring program.

1.6 Administrative, Legal and Policy Framework

1.6.1 Relevant administration

The Department of Water Affairs

The Namibian Department of Water Affairs (DWA) is currently the Central Government Authority with ultimate jurisdiction over the countries water resources. The Department forms part of the Ministry of Agriculture, Water and Rural Development and has a twofold responsibility:

- The management, control and conservation of Namibia's water resources with the aim of ensuring they are utilised on a judicious and sustainable basis.

- The supply of water to rural and urban consumers.

Prior to 1993, responsibilities for rural and bulk water supply were disseminated between the Department of Agriculture and Rural Development, and the Department of Water Affairs. Control and administration of both sectors has subsequently been transferred to the Department of Water Affairs. A separate Directorate for Rural Water Supply was established in January 1994 (Fry, 1995).

The distinction between bulk and rural water supply is a reflection of the two primary consumer groups: those members of society who make a subsistence living mainly in the rural areas, remote from any reasonably developed governmental or other institutional establishment (rural consumers), and those living in formal establishments such as villages or towns where reasonable services are provided and which may be regarded as the economically active sector of society (urban consumers) (Department of Water Affairs, 1995).

The bulk water supply function concentrates, in broad terms, on the reliable supply of water at acceptable service levels and quality standards to urban consumers. To fulfill this obligation the DWA currently operates 130 State Water Schemes and operates on a decentralised basis. Rural water supply aims at facilitating, training, community participation and, eventually self reliance of rural communities in respect of water supply (Department of Water Affairs, 1995). Most of the functions of rural water supply are catered for and subsidised by the government.

With over 80% of the communities of former Owamboland living in dispersed rural settlements, the provision of water is chiefly the responsibility of rural water supply as is the provision of water extension services. The Olushandja Dam, however, falls under the auspices of bulk water supply. Thus, under the present administrative structure, the management of the dam would fall to bulk water supply acting in close collaboration with rural water supply.

The administration of bulk water supply is, however, in a state of flux. The desirability and feasibility of restructuring the water sector in Namibia, based on the commercialisation of the bulk water supply function, is currently being investigated as a result of a Cabinet decision taken in 1993. The commercialisation would only apply to the water supply function of the Department of Water Affairs (Department of Water Affairs, 1995).

In the feasibility study for the restructuring of the DWA, commercialisation is defined as a process whereby a directly controlled State activity is transformed into a suitable form - a set of corporate values, as well as operational and financial motives, which will relate to the needs of its demand led market. The DWA will thus be reorganised as a company or a profit making body, but will not enter the private sector as the ownership of the commercialised entity is maintained by the government who becomes the sole shareholder and beneficiary. There will be a board of directors nominated by the government to oversee company policies. A number of previously state owned enterprises in Namibia have already been

commercialised, including the broadcast corporation, telecommunications, the meat corporation, transport services and SWAWEK.

The company will aim to operate on the basis of full cost recovery by setting tariffs on a user charge basis. At present the average tariff is significantly less than the actual cost of operating the bulk water services. The deficit in the running costs of the bulk water supply, excluding capital expenditure, has amounted to approximately N$16.3 million since Independence (Department of Water Affairs, 1995). A considerable increase in bulk water tariffs is inevitable if costs are to be recovered.

The company will not be responsible for water provision in rural areas. This will remain the function of the Directorate of Rural Water Supply. With regard to rural communities the government's objective is "to move from the role of provider to that of facilitator on the basis of community participation through water committees so that communities become self-sufficient to the fullest possible extent." (Department of Water Affairs, 1995).

The Owambo communities comprise the largest rural sector in the country with over half the population dependent on the pipeline-canal system which is regarded as a bulk water supply system. Although the Owambo people recognise water as an important resource and determinant of settlement patterns, provision of a secure supply by the central government has engendered the idea that water is a free resource and has not promoted a conservation ethic (Marsh and Seely, 1992). It is expected that the government maintain pipestands and take off points along the pipeline. Much water is wasted as taps are frequently left running to water herds of livestock and consumers do not regard the mending of leaking or damaged take-off points as their responsibility. Rural water supply has attempted to address the problem by introducing water committees with community representation to act as an interface between the consumers and government authorities. These committees have been a qualified success in reducing wastage but are not truly community based structures.

Part of the motivation for increasing water tariffs is to encourage consumers to regard water as a valuable commodity (Fry, 1995). The bulk water supply system, including the Olushandja Dam, will become the property of the commercial company and tariffs are likely to be set for purified (pipeline) and unpurified water. It is uncertain how any system of payment will operate in former Owamboland where the average per capita annual income is N$255 in rural districts and N$750 in urban areas. Comments on preparatory legislation concerning the establishment of the utility company by Glazewski (1995), question the concept of "customer" as defined in the Draft Namibia Corporation Act: "a person or body, incorporated or unincorporated, taking a supply of water in bulk from the Corporation" (Bill, fifth draft, 1 (1), 4/11/94). In light of this definition it is difficult to envisage how the interests of communities in poor rural areas may be served. It has been suggested that the Directorate of Rural Water Supply may act as the consumer and a secondary distributor of water on a more equitable basis in rural areas (Cashman, 1995).

In the feasibility study for commercialisation, it has nevertheless been recognised that certain state water schemes do not fit into the category of bulk water supply schemes, since the consumer groups are mainly constituted by rural communities in communal areas. The Calueque-Olushandja transfer operation would comprise such a scheme. It has been proposed that the status of all bulk and rural water supply schemes be evaluated and an appropriate classification be made prior to the transfer of bulk water supply schemes to the company (Department of Water Affairs, 1995).

At present it is difficult to predict how the Olushandja Dam may be administered and managed over the long term. The utility company is likely to assume a "guardian role" in the operation of the scheme (Cashman, 1995). The applicability of the cost recovery approach is likely to remain questionable for some time. In real terms, the government will still be responsible for the provision of water in rural areas and the development of services. The introduction of water tariffs in areas where water is generally regarded as a free and communal resource will have to be done gradually on a par with the rate of development in these areas. One of the assumptions of this study is that the recommendations will be initially considered by the DWA and subsequently by the public utility company. Restructuring of the water sector and the necessary institutional changes are not likely to be accomplished before the end of 1995 (Cashman, 1995).

1.6.2 Relevant policies

Namibia's Environmental Assessment Policy

Namibia's Environmental Assessment Policy was approved by a Cabinet resolution in August 1994 and officially published in January 1995. Although the final policy was not available at the time of commissioning of the present EIA, several aspects of the policy pertaining to social considerations in environmental assessment are nevertheless worth highlighting.

- At the outset the policy quotes Article 95 (1) of the constitution of Namibia which has a distinct anthropocentric focus.
- The policy stresses the governments recognition of the need for economic development, foreign investment and the alleviation of poverty.
- The policy makes special mention of the scarcity of water in relation to human and animal carrying capacities.
- The term "environment" is interpreted to include social, cultural, historical and political components.
- "Sustainable development" is defined in terms of wise utilisation and responsible management of Namibia's biophysical resources, for the benefit of "both present and future generations".
- An important component of the assessment procedure is to strive for a high degree of public participation and involvement by all sectors of the Namibian community in the EIA process.
- Maximising of benefits is stressed in conjunction with minimizing anticipated negative impacts.

- With regard to scoping reference is made to disadvantaged communities as important interested and affected parties. Proponents are specifically advised to consider *inter alia* the education levels, the socio-economic status and the reliance of such people on the resources likely to be affected as well as social, cultural and traditional norms within communities.

The EIA process described in the policy is based on South Africa's Integrated Environmental Management procedure. The procedure is intended to guide rather than impede the development process through an interactive approach which is pro-active, encourages participation and compromise as opposed to the strictly stop/go approach in other industrialised countries (Fuggle and Rabie, 1992).

These basic principles are reflected in the Namibian policy and the procedure itself differs from that of IEM in only two respects: Firstly, the policy requires that a proposal be submitted to an Environmental Commissioner, located in the National Planning Commission. The proposal has to be registered by the Commissioner, whose function it is to ensure that the proponent fully understands the EA procedure which needs to be followed. Secondly, the option of an Initial Assessment is not included as part of the procedure. Alternatively it is recommended that a pre-feasibility study is undertaken for large projects to determine whether a detailed assessment is required. In addition to these procedural differences a few of the recommended checklist items and considerations have been added or omitted.

The upgrading of the Olushandja-Calueque scheme incorporates several of the activities requiring EIAs listed in the policy including major dams and reservoirs, water transfers and the possibility of human resettlement. At the time of writing the institutional structures and appropriate legislation to encourage implementation of the policy had not been set up, although this intention is stated in the policy by the Minister of Environment and Tourism. Nevertheless, Sector Ministries, the Private Sector, NGO's and prospective investors are encouraged by the Minister to comply with the policy for all future development projects, programmes and policies.

The present study incorporates the principles underlying the South African IEM procedure to the fullest possible extent given some exceptional circumstances. It will thus inadvertently fulfill most of the requirements of Namibia's Environmental Policy.

Dutch Government policy regarding EIAs

Although there are no internal legislative requirements for EIA's in Namibia, comprehensive assessments are generally required by the various donor agencies giving assistance to Namibia, before they invest in a development project. The upgrading of the Calueque-Olushandja scheme receives financial assistance from the Dutch government (Directorate General for International Cooperation). Allocations are made as various phases of the upgrading project are implemented.

The cooperation between the Netherlands and Namibia began in 1990 - the first year of Namibian independence. In 1992 a permanent representative of the Netherlands government was stationed in Windhoek. With regard to financial assistance the Dutch government decided to focus on developing the rural sector and on rural water supply projects in particular (DDGIC, 1993). Among these were the Ogongo-Okalongo and the Oshakati-Omakongo pipeline schemes, and the rehabilitation of the Calueque-Olushandja Water Supply Scheme (phase 1). A number of other water development projects in north-central Namibia are being financed by the Netherlands. An EIA is generally required for approval of project proposals. Often urgency and public pressure prompts the Department of Water Affairs to initiate projects without prior approval from the Netherlands. This could explain why the necessary infrastructure to upgrade the Olushandja Dam is in place before the EIA has been completed.

The Netherlands have produced a set of guidelines explaining the importance of EIA and describing the various stages in its application to the project cycle. At the outset the Netherlands embassy in the recipient country is responsible for conducting initial environmental screening based on checklists relating to selected activities and identified environments (DDGIC, 1993). After the initial screening a number of key elements of EIA in planning and policy are identified. It is stated that if an EIA is not a statutory requirement in the recipient country, DDGIC can make this inclusion a prior condition for the funding of certain projects. Other key elements include scoping and public participation which would entail an active effort to "obtain the views of the indigenous population on projects which could have significant environmental effects" (DDGIC, 1993).

According to the guidelines, EIA is obligatory for certain categories of projects in particularly environmentally sensitive areas. Such projects include those relating to the exploitation of hydrological resources, and those undertaken in specified areas "in use by indigenous people and areas of particular cultural value" (DDGIC, 1993). Under these criteria, an EIA for the upgrading of Olushandja Dam is obligatory. The details of the EIA procedure identified in the DDGIC guidelines, are covered by the Namibia's Environmental Policy and the IEM procedure. Accordingly, EIA must be integrated into the project cycle from the identification stage through to project evaluation. To include such advice on the behalf of the donor country is somewhat paradoxical when the government of a recipient country has to prove the feasibility of a project to qualify for the financial assistance required to undertake an EIA. Inevitably, as is the case with the Olushandja upgrading scheme, EIA is applied to projects which have already been determined and justified on the basis of engineering, technical and economic feasibility. The EIA or SIA can consequently lead to suggested mitigation measures, but can have little effect on the project design.

1.6.3 Legislative Requirements

Various components of the Namibian legal system may have to be referred to at various stages of the development of the water transfer and distribution scheme. Three aspects of Namibia's legislation have been identified as having particular relevance to the SIA of the upgrading of Olushandja Dam. Firstly the

recently adopted constitution of Namibia which contains some interesting and well known environmental provisions. Secondly, the Water Act of 1956 (Act 54 of 1956), which is the principle Act legislating the water sector. The latter falls into that category of legislation of which the general purpose is not environmental conservation or management but which includes individual provisions with that aim (Fuggle and Rabie, 1992). Finally, the much anticipated Traditional Authorities Bill, currently before parliament, may hold implications for the way in which compensatory measures are administered.

The Namibian Constitution

The environmental clause in Namibia's constitution is contained in Article 95(1):

> "The state shall actively promote and maintain the welfare of the people by adopting, *inter alia*, policies aimed at the following:
>
> (1) that the ecosystems, essential ecological processes and biological diversity of Namibia are maintained and living natural resources are utilised on a sustainable basis for the benefit of all Namibians, both present and future..."

This section falls under that part of the constitution dealing with "Principles of State Policy". Significantly, these directive principles are devoted to economic or social rights, third generation rights as opposed to fundamental rights which reflect the philosophies contained in the Universal Declaration of Human Rights (Glazeskwi, 1993). In support of this distinction, it is argued that environmental public goods cannot be made the subject of individual or fundamental rights. The incorporation of the environmental clause as a directive principle is an acknowledgement that some kind of group or communal right in public goods does exist (Glazeskwi, 1993).

This aspect of the Namibian constitution would appear to have special relevance in communal areas of Owambo where the concept of group rights is a cultural and social phenomenon. Whether purposefully or inadvertently, such rights have been given legal weight although it remains to be seen what practical effect the environmental clause will have in the case of communal areas.

There is some debate as to extent to which third generation rights are enforceable in a court of law. Unlike human rights, which are self operating, the enforcement of group rights theoretically requires some kind of legislative initiative by the state (Glazewski, 1993). This is to some extent provided for in the in the powers of the Omsbudsman, established under chapter 10 of the Namibian constitution (Glazewski, 1993). This is a parliamentary office concerned with the independent investigation of complaints against the administration. The role of the Omsbudsman is especially significant in cases where judicial review of administrative decisions and other remedies are unavailable or insufficient (Fuggle and Rabie, 1992).

Included in the functions of the Namibian Omsbudsman is "the duty to investigate complaints concerning the over-utilisation of living natural resources, the irrational exploitation of non-renewable resources, the degradation and destruction of ecosystems and the failure to protect the beauty and character of Namibia" [Article 91(c)].

If the violation of group rights is not recognised in a court of law an independent investigation may be launched through the Omsbudsman, the results of which are reported to Parliament. Such means are however only accessible to educationally and financially empowered sectors of society. In rural communal areas where third generation rights to a water resource such as the Olushandja Dam are assumed it is difficult to predict how these environmental clauses may be enforced despite the extent of over-utilisation and exploitation of resources in such areas.

More fundamentally the environmental clause in the constitution is justified in terms of promoting the "Welfare of the People" who in turn may well be regarded as part of the "beauty and character of Namibia", particularly in the case of the Owambo nation and other ethnic groups who have their own unique cultural identity. Despite the apparent emphasis on the biophysical aspects of the environment in the relevant clauses of the constitution, a broad interpretation could well shift this focus to be more socially orientated. Such an interpretation may be more appropriate in communal areas where extensive resource utilisation is vital to the survival of the local inhabitants.

The Water Act of 1956 (Act 54 of 1956)

Control over impoundments of water is regulated by the Water Act of 1956 (Act 54 of 1956). The Act has been inherited from the South African administration and has not been revised since Namibian independence. According to Barbour and Larsen, 1994, owing to the Roman Dutch basis of South African law, the assumption underpinning the Water Act is that there is a plentiful and regular supply of water in rivers throughout the year. In the Namibia, with its semi-arid climate, this assumption is seriously flawed. The document does not contain a general underlying principle of environmental conservation or reference to EIA's and very little control over the construction of dams is provided for by the Act. Many of the clauses regarding impoundments deal with cases of public water on privately owned land and are consequently not applicable to the bulk water supply network in former Owamboland.

Of some relevance is that no waterworks storing more than 250 000m^3 of public water may be constructed without a permit issued by the Minister. This permit to build the Olushandja Dam with a capacity of 42.29 x $10^6 m^3$ would have been acquired in 1971 and no additional permit will be required for the upgrading scheme. The Minister may construct any waterwork which he may deem necessary for the conservation, utilisation, storage or supply of water and he may distribute water from these waterworks as he may deem appropriate (Fuggle and Rabie, 1992). The Minister may reserve areas for the construction of water works when he is of the opinion that this would be in the public interest. Furthermore the Minister may expropriate land for the construction of government waterworks - ownership and control of

water in such waterworks vests in the State (Fuggle and Rabie, 1992).

There is consequently no legal constraint to the upgrading scheme. People who may feel aggrieved by the additional impoundment of water in the Olushandja Dam will have few legal rights in terms of the Water Act as they are not private owners of land. The only person who may be entitled to approach the Water Court would be the Headman. Legally the State has jurisdiction of the Olushandja Dam and all the activities that are associated with it.

Important to note is that the existing Water Act of 1956, as applicable in Namibia, is not regarded as fully appropriate to the particular water environment of the country, and has become outdated due to changes which have taken place in the water sector and country as a whole (Department of Water Affairs, 1995). It has, however, been proposed that the drafting and promulgation of a new Water Act should be pursued as a matter of urgency, particularly in the light of the impending changes to the Department of Water Affairs and the formation of the public utility company (Department of Water Affairs, 1995). Accompanying the new Water Act will be a separate statute to cover irrigation (Marsh and Seely, 1992). Such a statute is likely to have considerable relevance to any plans to further utilise the Olushandja Dam for irrigation purposes.

In the operation of its business, the utility company will be subject to the Companies Act of 1973 as well as the Water Act and regulations made thereunder (Department of Water Affairs, 1995).
It remains to be seen how a new Water Act will deal with the administration of impounded water in communal areas and what relevance the new legislation may have to future use of the Cunene River.

With regard to other natural resources, there is legislation in force aimed at protecting soils, trees, wildlife and selected plants (Marsh and Seely, 1992). These provisions are inadequate and do not adequately address the problem of conserving indigenous resources without endangering or jeopardizing the livelihoods and requirements of subsistence communities in rural areas.

The Traditional Authorities Bill

The Traditional Authorities Bill (Namibian Government, 1994) represents an attempt on behalf of the government to distinguish between the roles of the traditional tribal leaders, and the newly elected Councillors and municipal authorities. The political representatives are responsible for the administration regions redefined in the Magistrates' Court Act of 1944 by notice in the Government Gazette, No. 799, 1994 (Ministry of Justice, 1994).

In a survey undertaken by the National Planning Commission in cooperation with the SSD of the University of Namibia, traditional and political leaders were questioned on how they might relate to and interact with one another. The unanimous response was that they were awaiting the promulgation of the Traditional Authorities Bill (National Planning Commission, 1994). This much anticipated item of

legislation is currently before parliament. Significantly, the bill makes no reference to the most contentious issue in communal districts, namely the administration and control of land.

According to Werner (1995) of the Ministry of Lands and Resettlement, there has been no revised policy on communal land since the instigation of the South African Land Act of 1936. Although this act is no longer enforceable and was never really applied in Namibia, it has yet to be formally repealed. In communal areas, land is acquired through customary means and can consequently not be regarded as part of an individual's personal estate. Land is traditionally regarded as a communal resource and right of usufruct is granted by the king or headmen. Since their election, Regional Councils are officially responsible for administering Settlement Areas. Councils do, supposedly, need to approach traditional leaders concerning land that needs to be allocated for development projects (National Planning Commission, 1994). According to the Traditional Authorities Bill, tribal authorities have a duty to assist and co-operate with the organs of the central, regional and local government in the execution of their policies by keeping the members of the traditional community informed of development projects in their area [article 10.2(b)].

Despite this emphasis on interaction and cooperation, a traditional authority is refrained in article 12 (1) from any acts which undermine the authority of those institutions as established by the law. Furthermore, where the powers of the traditional authority conflict with the powers central government or local and regional authorities, the powers of the one of the latter, as the case may be, shall prevail [article, 12.(2)]. On passing of the Bill, traditional authorities will thus be sub-ordinate, by law, to political Councillors. This can effectively be justified on the basis that the Councillors are democratically elected representatives. There are no precedents in developed countries where inheritance-of-title based structures take responsibility for political administration and decision-making. Traditional land tenure is, nevertheless, a functional system that Owambo communities respect and are accustomed to.

In the vicinity of the Olushandja Dam there appears to be widespread acceptance of the headman's authority. It must be acknowledged that tribal powers will inevitably be increasingly undermined by legislative provisions such as those in the Traditional Authorities Bill, for the sake of political expediency. But in the interim, communication and interaction with the people can be best effected via the headman. The democratic tradition in Namibia is still in its infancy and it is unrealistic to expect a dramatic change in allegiance amongst communities whose lifestyles and farming practices are still, to a large extent, governed by historically derived customs and beliefs. In the administration and mitigation of impacts associated with the upgrading scheme, a compromise should preferably be sought in the diffusion of power and responsibility between political and traditional powers.

2 THEORETICAL CONSIDERATIONS

2.1 Linkages between SIA, EIA and Integrated Environmental Management

An environmental impact assessment is intended as a purposeful activity, the purpose being either to discourage or modify a project that may have detrimental environmental or social effects, or to reinforce a project that has positive environmental or social effects (Brown, 1990). To achieve these aims in developing countries, an EIA has to be appropriate to the context in which it is being applied. This would include both the institutional framework and relevant decision making process, as well as the affected environment. One way of doing so is to adapt the EIA process, as defined by NEPA, to the developing countries' needs and circumstances. In the opinion of Wandesforde-Smith *et al* (1985), major contributions to the debate about EIA in the developing world revolve around the question of technical and procedural models likely to prove attractive to developing countries, and still ensure adequate protection of the valuable intrinsic qualities of the environment.

Early efforts to stimulate interest in EIA in developing countries focused on methods, techniques and available models from western industrialised countries. These procedures, which have largely evolved from NEPA, are dependent upon an ethic of environmental conservation, espoused by voters and enforced by law (Fuggle, 1990). According to Fuggle and Rabie (1992) the models direct considerable attention to long-term ecological criteria, aesthetic considerations and scientific or educational interests. In less developed countries, such as Namibia, these requirements are regarded by the average citizen to be luxuries. Many of the NEPA based models have consequently proved inappropriate and unworkable in the context of developing economies (Wandesforde-Smith *et al*, 1985). Furthermore, public response to such assessments is often reactive and excessively negative as they are perceived as a cause of delay to the development process (Fuggle and Rabie, 1992). In order to be accepted by the majority, EIA's have to reflect the values and norms of the affected public.

A variety of adaptations of the EIA procedure have been proposed for conditions associated with the process of development. The inherent challenge to such alternatives is the dual requirement of adaptation to a developing context and of retaining technical competence and credibility. The Integrated Environmental Management Procedure (IEM), proposed by South Africa's Council for the Environment (Department of Environment Affairs, 1992), is an example of such an adaptation which has been successfully implemented in the assessment of a number of development projects (HSRC, 1993).

The recently adopted Environmental Policy of Namibia (1995) is similar to the IEM procedure and is based on the same principles. The most significant of these principles as far as development projects are concerned is the requirement of pro-active and positive planning. In this regard, the objective of IEM is not to impede development, but to provide an effective approach using interactive and iterative evaluation techniques, to improve a proposal or suggest more environmentally acceptable ways of meeting the objectives of the development proposal (Fuggle and Rabie, 1995). This allows associated benefits to be

enhanced and negative impacts minimised, without jeopardizing the project as a whole.

IEM differs from the EIA process espoused by NEPA in that it seeks to introduce environmental concerns into development actions by integrating them fully with planning and management and it seeks to reduce the anti-development perception of EIA which exists in some developing countries (Fuggle, 1990). Central to the notion of IEM is that its underlying principles should direct the planning of proposals rather than be secondary considerations. Experience in the use and application of IEM has suggested that, unlike NEPA based western models, the principles underlying the process may be more important than the procedural aspects. Focus on the IEM principles allows a good deal of flexibility and versatility in the application of IEM to both policy, and project design and implementation.

In the light of this relationship between conventional EIA's developed in an industrialised context and the concept of IEM, the definition and applicability of SIA in developing countries must be considered.

SIA originated in the United States in response to legal interpretations of NEPA. A series of court decisions mandated that federal agencies and project proponents include an analysis of "social effects" in development decisions (Burdge, 1990). According to the Council of Environmental Quality's (CEQ), regulations for implementing the procedural provisions of NEPA, economic or social effects are not intended by themselves to require preparation of an environmental impact statement (EIS). However when an EIS is prepared "and economic or social and natural or physical environmental effects are inter-related, then the EIS will discuss all of these effects on the human environment" (Interorganisational Committee on Guidelines and Principles for SIA, 1994, pp 110).

Despite this emphasis on integration of social and biophysical aspects, a large body of literature focusing exclusively on SIA testifies to the fact that social assessments have developed as a distinct sub-field of SIA and a discipline in its own right. A significant proportion of this literature focuses firstly on the use of SIA to assess the consequences of water development projects involving resettlement (Egre, 1990; ICOLD, 1992; Bisset, 1984) and secondly, of SIA as a technique appropriate to development projects where impacts are often borne by the poorest and most vulnerable sectors of the population (Burdge, 1990; Nesbitt, 1990; Hindmarsh, 1990; Rickson *et al*, 1990b)

The similarities between social and biophysical impacts are demonstrated by the way in which they may vary spatially, temporally and in terms of desirability and intensity (Interorganisational Committee, 1994). A major difference, however, is that the biophysical environment is a passive entity dependent on specialists to make decisions in its best interest, whereas the social environment has the potential to participate actively in the decision making process. Whereas biophysical factors can often be empirically classified and monitored, SIA involves a study of subjective factors such as quality of life, and the development of more culturally sensitive approaches, particularly when disadvantaged ethnic groups and minorities are involved (Craig, 1990). A further distinction between the natural and social environment is that the latter can react in anticipation of change. People may also adapt in reasoned ways to changing

circumstances if they are involved in the planning process.

There must consequently be a fundamental distinction between approaches toward affected people versus the affected natural environment, and yet the inter-relationship between social factors and ecological systems must still be acknowledged. In this regard, the role of SIA and its relationship to EIA can be viewed in a number of ways. Some regard SIA as a method for incorporating social factors into EIA through the identification of those features of the social environment that have the greatest potential to affect or be affected by a proposed project or policy change (Burdge, 1990). This view sub-ordinates SIA as an assessment tool or singular component in the broader context of an EIA. Social input is thus equated to and assessed using an approach similar to that used for specialist input concerning biophysical factors such as fauna or vegetation. This may be appropriate to the assessment of socio-economic impacts, such as demographic changes and employment opportunities which are readily evaluated, ranked or calculated using well understood techniques. These can provide an indication of the magnitude and scale of likely change comparable to the nature of the biophysical impacts. Other categories of social impacts, such as those relating to community interactions, visiting patterns, psychological attitudes, values and the importance and significance of features of the environment, cultural life including rituals, communal activities and general life-style, require a type of evaluation that cannot be easily integrated into a standard EIA.

The above categories are particularly relevant to communities in developing countries characterised by distinctive cultural heritages and value sets. It is in such communities that the activities of the people are most closely associated with their natural environment and ecological changes impact on social organisation and *vice versa*. It is consequently important not to attempt separate reports on environmental and social impacts that are prepared in isolation (Bisset, 1984). The concept of a human environment which, as defined by the U.S. of Environmental Quality, represents an interface between biophysical and social environments, becomes relevant. In assessing impacts of development projects in populated, and in many cases, impoverished rural areas, one is inevitably dealing with a human environment.

This acknowledgement does not alleviate the terminological problem of distinguishing between an SIA and EIA. It may be necessary to consider an "either/or" scenario whereby an SIA, based on the concept of a human environment, is conducted in preference to, rather than as part of, an EIA. The decision would, unavoidably, be based on an instinctive and subjective judgement at the outset whether the impacts on the human environment are more important than the biophysical impacts. In developing countries such a decision could be supported in terms of the linkages between impact assessment and development focused on achieving greater social benefit. The use of SIA can be regarded as a means to mitigate past attempts at development which have often been characterised by mismatches between the aims of the project and affected communities (Burdge, 1990). According to Brown (1990) the environmental impacts of development in non-industrialised countries encompass social dimensions of change more so than in developed countries. He consequently regards SIA and EIA as synonymous in the development context.

The IEM concept already represents a step forward in this regard by its emphasis on socially responsive environmental planning. There are three stages to the IEM procedure corresponding, firstly, to the development and classification of a proposal, secondly, a decision as to the acceptability of the proposal, and finally to the implementation and monitoring of the development (Fuggle and Rabie, 1992). A detailed description of these three stages is provided in the Integrated Environmental Management Guideline Series (Department of Environment Affairs, 1992). Stage 1 of the procedure makes provision for an Initial Assessment - an investigation undertaken to obtain just enough information to determine whether or not there will be significant impacts (Department of Environment Affairs, 1992). At this stage it may prove useful to determine the nature as well as the extent of impacts as a basis for deciding whether a full impact assessment is required and if this assessment should have a particular focus.

Brown (1990) argues for a pragmatic approach to impact assessment in developing contexts whereby only the most pertinent aspects of the EIA are accorded significance. Other impacts are still acknowledged as potentially important, but not worth the same degree of investigative and financial resources. Such pragmatism is particularly relevant to the consideration of alternatives and the "no-go" option. In the case of the Olushandja Dam the dynamics of the development process are such that this type of flexibility is not realistic. The same applies to the preservation and replanting of endemic species that might be detrimentally affected by an increase in the level of the dam. From a western perspective, such species may be defined intrinsically in terms of philosophic or aesthetic values (Murphree, 1995). From the perspective of the subsistence communities in the vicinity of the Olushandja Dam, floral species are defined instrumentally in terms of human survival objectives and use value. Preservation of endemics may consequently not always be the most realistic option in a particular context. This pragmatic approach may help establish a particular emphasis which could well distinguish a social impact assessment from an environmental impact assessment.

This idea is closely associated with the IEM approach to solving problems associated with development rather than prohibiting development. There is, in fact, considerable overlap in the principles of IEM (Department of Environment Affairs, 1992) and those of SIA, as defined by the Interorganisational Committee on Guidelines and Principles for SIA (1994).

SIA PRINCIPLES	IEM PRINCIPLES
Identify and involve all potentially affected groups and individuals. Plan for gaps in data	Consultation with interested and affected parties. An open and participatory approach in the planning of proposals.
Analyse impact equity by clear identification of winners and losers and emphasise the vulnerability of under-represented groups.	Attempt to ensure that the "social costs" of development proposals (those borne by society, rather than the developers) be outweighed by the "social benefits" (benefits to society as a result of the actions of the developers).
Focus the assessment: deal with issues and public concerns that "really count" not those that are "easy to count".	Democratic regard for individual rights and obligations.
Define how the SIA was conducted, what assumptions were used, and how significance was defined.	Accountability for decisions taken.
Provide feedback on social impacts to project planners and identify problems that could be solved with changes to the proposed action or alternatives.	Due consideration of alternative options.
Use SIA practitioners or trained social scientists.	Let there be opportunity for specialist and public input in the decision making process.
Establish mitigation and monitoring programs to manage uncertainty and adverse impacts.	Attempt to mitigate negative impacts and enhance positive aspects of proposals. Comply with principles during all stages of the planning, implementation and decommissioning of proposals.
Use published scientific literature, secondary data and primary data from the affected area. Identify data sources.	Informed decision-making and accountability for decisions taken.

Table 1: Principles of SIA and IEM

From Table 1 it is evident that, although there may be methodological techniques that are unique to SIA, the basic principles underlying SIA and IEM are compatible. Both procedures emphasise public involvement and equitable decision-making and there are no areas of conflict.

All three stages in the IEM procedure have been incorporated into Namibia's Environmental Policy (Ministry of Environment and Tourism, 1994) (Fig. 6). A significant difference is the omission of the Initial Assessment component of the procedure in the Namibian version, although the text of the relevant documentation does recommend a pre-feasibility study for large projects. Based on the findings of this, a more detailed feasibility study may be undertaken. The Terms of Reference for the detailed feasibility

study should be established during the pre-feasibility study (Ministry of Environment and Tourism, 1995).

The Namibian Environmental Policy had not been released at the time of commissioning of the present study. Nevertheless, the approach adopted by the research team to the SIA is based on the principles of IEM and attempts to follow the IEM procedure. The study does, however, employ techniques of public participation and involvement that are specifically associated with social assessment and hence the study may be regarded as a social impact assessment. The study does not attempt to replace an EIA and focuses on the social consequences that are likely to result from specific government actions, in accordance with the definition of SIA by the Interorganisational Committee (1994).

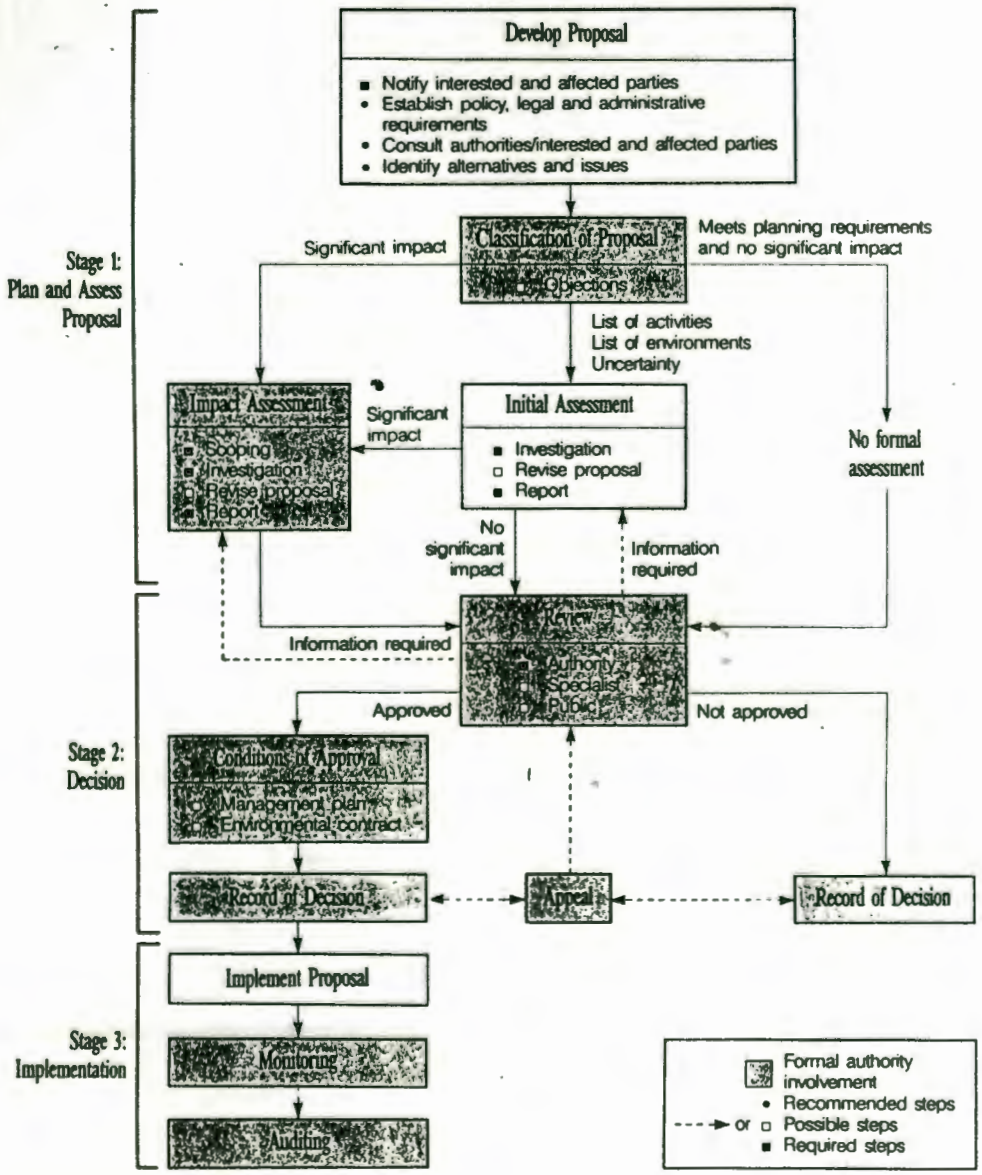
Significantly, three of the other specialist reports commissioned by the Department of Water Affairs have a direct bearing on the social impact of the upgrading scheme. These reports deal with the distribution of freshwater snails and snail-borne diseases (Curtis, 1995), the influence of the Olushandja Dam on groundwater reserves (Department of Water Affairs, 1995) and the distribution and species of freshwater fish (Hay *et al*, 1995). Only two of the specialist reports are of a purely biophysical nature - the limnology report (Roberts, 1995) and a report on aquatic and wetland plants (Burke, 1995). The SIA will take the results of these studies into account.

2.2 Fulfilling IEM Requirements

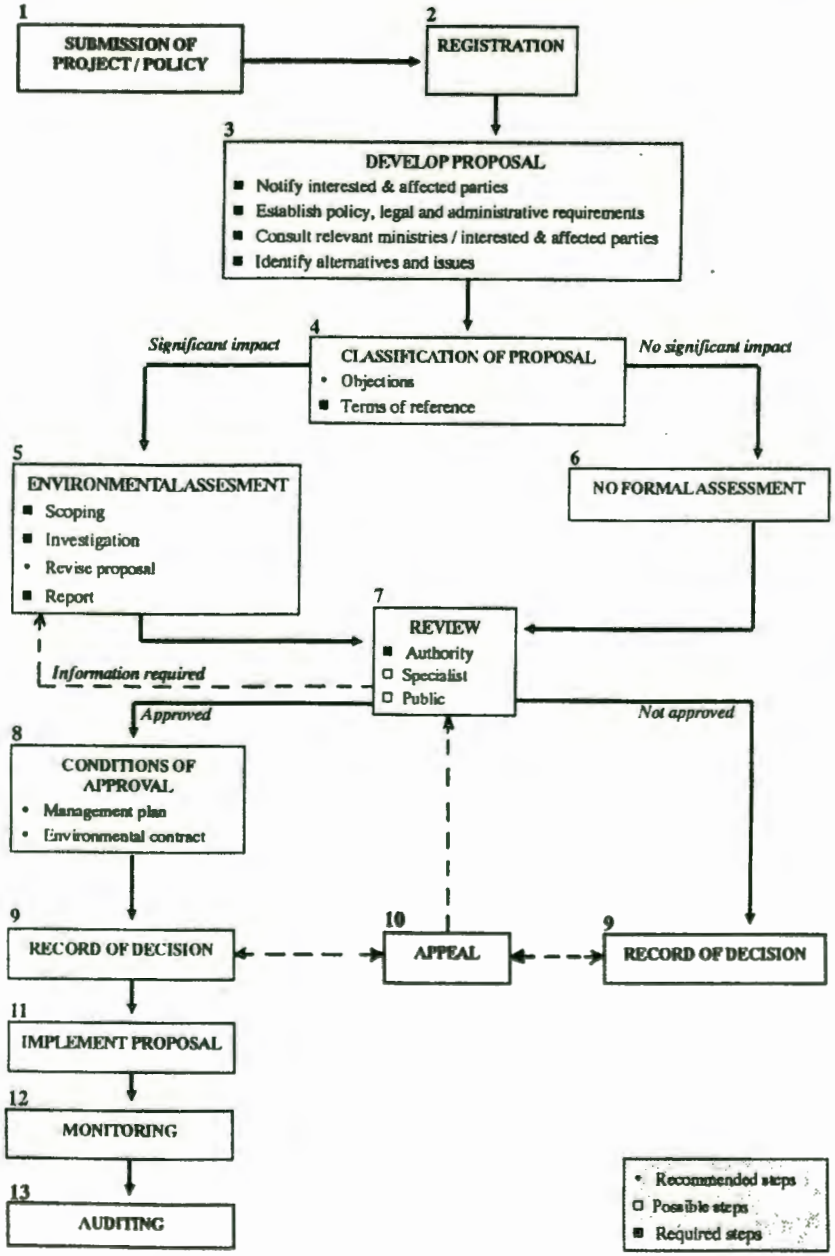
IEM demands that environmental impact assessments be viewed as an integral part of the project planning process. It should begin with an early identification of alternatives and examine the potentially significant impact of the project actions associated with each of these. The IEM principles should be adhered to through the project cycle and ideally should be followed by monitoring and post-audit evaluation. Since the present study reflects an integration of SIA techniques in the context of IEM, it remains relevant to briefly consider the extent to which the present study fulfils the requirements of IEM.

Stage 1 of the IEM procedure deals with the planning and assessment of a proposal. With regard to planning, IEM requires that all interested and affected parties are notified and consulted, and alternatives identified and considered. In the case of the Olushandja Dam, the nature of the development project and the background to the project precludes the fulfilment of these requirements. Since the necessary infrastructure for the upgrading scheme was largely in place by the end of 1994, the consideration of alternatives is retrospective and cannot form part of the terms of reference for the SIA. It is suggested in the literature (Kakonge and Imevbore, 1993; Brown, 1990) that most impact studies in developing countries encounter similar difficulties, particularly when international funding is sought for a specific development.

THE IEM PROCEDURE



ENVIRONMENTAL ASSESSMENT PROCEDURE



With regard to bulk water supply in north-central Namibia, there was a lack of scoping and consideration of alternatives at a local and regional level at the outset - when projects were initiated in the 1960's. The exact nature and distribution of demand for water in Owambo is yet to be quantitatively defined. A number of impacts of bulk water system of canals and pipelines were inadequately investigated. For example, as a result of the construction of the Olushandja-Ogongo canal and the all-weather road that runs parallel to it, the flow of water in the *oshana* system has been altered, reducing the supply of water south of the canal for groundwater recharge, vegetation growth as well as livestock and human consumption (Marsh and Seely, 1992). The provision of alternative and more secure water supply has also led to changes in the seasonal movement patterns of people and livestock in response to the availability of water. Communities have become more sedentary and settlement has been induced in the vicinity of water infrastructure often leading to severe localised environmental degradation.

The Olushandja Dam was designed to utilise a portion of the natural Oshana Etaka which used to form the main drainage channel between the Cunene River and Lake Etosha. Local communities still refer to Olushandja Dam as the Etaka. There is no record of environmental considerations prior to dam construction. Owing to high evaporation losses, the efficiency of the dam is very low and costly when the yield from the dam is compared with the volume abstracted at Calueque (Lund, 1992). It has been suggested that only 7.7% of the water pumped into the Olushandja Dam is effectively used (Department of Water Affairs, 1993).

Alternatives designed to reduce evaporation loss by reducing the capacity of the dam were considered in a report commissioned by the Department of Water Affairs in 1992. The investigation focused on the engineering and financial feasibility of reducing the dam capacity from 42.29Mm^3 to either 34.23Mm^3 or 22.43Mm^3, and the effect this would have on surety of supply (Lund, 1992). Physical alterations would entail the relocation of the south bank outlet works and the extension of the Etaka Canal. In a subsequent report compiled by the same consultancy in 1995, the implication of zero storage capacity for surety of supply was assessed. This, in turn, would entail the elimination of the south bank outlet works and the construction of a feeder canal linking the existing Calueque-Olushandja canal to the Etaka canal. The biophysical and social impacts of these alternatives have not been investigated. The specialist recommendation to retain Olushandja Dam at its present capacity and repair damage to the north wall pump station on the basis of minising costs and maximising surety of supply, was accepted by the Department of Water Affairs.

With regard to the provision for storage at Calueque Dam, alternatives will have to be considered owing to the conflicting interests of a number of stakeholder with vested interest in the Cunene River, including SWAWEK (South West African Water and Electricity Commission), the Angolan Government, the Namibian Government and various conservation groups concerned with the downstream effects of several storage and hydro-electric schemes proposed for the Cunene River. Three sites have already been developed (Gove Dam, Calueque Dam and Ruacana) and a further site has been identified at Epupa Falls for the development of a hydro-electric scheme. Like Calueque, Gove Dam further upstream was

designed to regulate flow of the Cunene for optimal power generation at Ruacana. Gove Dam was also damaged during the war and will have to undergo repair. It can be argued that because of the regulation of flow in the Cunene by Gove Dam, provision for storage at Calueque is not necessary to optimise the efficiency of the Ruacana hydroelectric scheme which at present operates at approximately 50% of its rated capacity (Brand, 1995).

Lack of provision for storage at Calueque will diminish surety of supply to Namibia (Lund, 1992) as diversion of water into the approach channel supplying the Calueque pump-station can only take place when the water level exceeds 1088.17m a.m.s.l. (Department of Water Affairs, 1992). It is possible that water may not reach the pump station during periods of low river flow. The decision whether or not to impound water at Calueque will thus have consequences for the management of Olushandja Dam. Such a decision has to be made in conjunction with SWAWEK who have serious objections to the amount of water lost to evaporation from Olushandja Dam (Brand, 1995; Haussler, 1995). The alternatives need to be considered in the context of a regional EIA which focuses on the Cunene catchment as a whole using a systems approach.

The shortcomings related to the planning of the initial proposal and project development, represent the most significant limitation to fulfilling the most important requirements of IEM. In this regard, the present study reflects the problems associated with the early evaluations using a NEPA based approach to EIA (Fuggle, 1990). The EIA was commissioned after the detailed design phase of the engineering aspects of the development project had been finalised and implemented based on regional and national consideration of benefits. At this late stage, the SIA is essentially a reactive undertaking partially limited to the identification of mitigation measures. Such assessments rely on the ability and willingness of the decisionmaker to terminate the project if unavoidable adverse impacts are identified. This type of decision is generally unlikely in developing countries when considerable sums of money have already been invested (Fuggle, 1990). It is certainly an unrealistic consideration with regard to the upgrading of the Olushandja Dam.

The current study is by no means invalidated by this limitation as the problem is common to many projects in developing countries, particularly those supported by foreign aid (Kakonge and Imevbore, 1993; Chonguica and Stromquist, 1994). It thus seems more practical to try and alleviate the implications of the problem in the interim period during which developing countries have the opportunity take policy initiatives, decide what they want from an EIA and how to use external assistance in pursuit of their goals. According to Wandesforde-Smith *et al* (1985) for the most part, people in developing countries have not had to define for themselves the problems for which EIA /SIA is presumably the solution; aid agencies and others have done this for them. Until IEM type procedures become legislated and standard practice in developing countries, economic and engineering considerations will remain important determinants of project feasibility. Rather than be ignored in the attempt to implement procedures such as IEM, the consequent constraints should be acknowledged and mitigated as far as possible using appropriate procedures.

Due consideration of other important requirements of the IEM procedure have been given in the present study, including an investigation of legal, policy and administrative requirements and a scoping exercise to determine the approach to the investigation of social impacts of the upgrading scheme. Recommendations for mitigation and monitoring are also included. Some of the mitigatory measures will be in the form of compensation for negative impacts of the present upgrading scheme as well as for the adverse consequences of the initial dam construction. In this regard it was not practical to measure all of the components relating to the compensatory provisions in the time available. In the event of more information being required, recommendations for further studies are made and it is proposed that such studies be transparently motivated and involve all impacted sectors of the community.

2.3 Study Approach

The approach to the SIA is based on a number of factors related to the nature of the project itself as well as the impacted community. The following considerations are taken into account in justifying the study approach:

- The stage of project development at time of commissioning of the SIA.
- The practical limitations for the decision-maker associated with the recommendation of far-reaching changes and compensatory mechanisms.
- An acknowledgement of the value of the SIA as an interactive learning process for the practitioners, decision making authorities and the affected individuals and communities.
- An appreciation of the fundamental differences in the cultural background and social values of the researchers and the impacted communities.
- Difficulties associated with applying SIA techniques to a set of impacts that are ill-defined and complex in terms of both spatial and temporal dimensions.

Freudenburg (1986) regards SIA as a "hybrid" - a field of applied social science, based on a fairly ancient lineage, and a crucial component of the policy making process, an aspect which has recently emerged. The practice of SIA has, in fact, advanced considerably since it began as a social science discipline in the early 1970's (Finsterbusch, 1985). Initially there was considerable uncertainty about what SIA's should study and how the studies should be undertaken. During the 1970's the general methodology of SIA was developed along with more specific types of methodologies for specific types of SIAs (Finsterbusch, 1985). These methodologies deal with the conceptual orientation of SIA and the most common distinction is between technical and political or participatory models of SIA. These two approaches to SIA reveal conflicting views about scientific knowledge, the role of specialists and the public as well as the process and desirability of social change (Craig, 1990).

The technical model is based on the logical positivist philosophy of science which, like the natural sciences, seeks patterns and regularities on which to base prediction and planning. The decision making process is consequently portrayed as being objective and relies on processed or factual inputs and

measurable social indicators. The political model is far more subjective, value laden and critical. It focuses on the process of community development and democratic decision making. In this regard the political approach is responsive to the affected public rather than responsible for maximising social welfare by efficiently facilitating development. Whereas the technical approach relies on experts and professionals as proponents for community interests, the political approach aims at empowering communities to take control of the decision-making process.

Sources of information differ between the two approaches. The technical approach tends to rely on secondary sources of demographic and socio-economic data and the political approach relies on input from key informants, community forums and structured or unstructured interviews. As opposed to reductionist and objective, the political model is holistic and subjective, orientated towards qualification of information and concerned with improving communications between local people and external decision makers. In this way conflict over social values is perceived as the reality in environmental controversies to be debated and resolved in a democratic manner. Significantly, the political approach also accords attention to the historical and cultural context of the SIA (Craig, 1990).

There is a fairly extensive literature dealing with methodologies and techniques of analysis appropriate to the technical approach to SIA. Less attention has been given to the methodologies appropriate to the political model (Craig, 1990). Hindmarsh (1990) suggests that it has become common practice wherever less developed countries are adopting impact assessment, it is the technical level form that is being chosen. This form has serious limitations as far as successful, sustainable and appropriate development initiatives are concerned, particularly when the background and context of a project does not conform to the implicit and explicit assumptions of the technical model.

According to Hindmarsh (1990), the underlying functionalist approach to the technical model fails to recognise the interdependency within, or between, impact variables. This is particularly relevant to environments characterised by significant connectivity between human and ecological systems. A further limitation to the technical model is its use of procedural methodologies which, according to Hindmarsh, cannot accurately identify or reflect community needs. In developing countries, the approach often relies on incomplete data banks, poorly appropriated funds and concepts of scientific rationality that cannot reflect the developing political economy.

Table 2 provides a summary of the most important differences between the technical and political models compiled using source materials Finsterbusch and Wolf (1977), Craig (1990), Ross (1990).

	TECHNICAL MODEL	POLITICAL MODEL
Scientific Theory	Logical positivism: focuses on patterns and regularities	Critical social theory: perceives conflict and controversy
Decision -making	Objective, efficient and rational, emphasis on the scientific method. Focus on the end result, product orientated and responsible.	Subjective and value laden, encourages debate and intervention to clarify issues. Focus on the means to the end, process orientated and responsive.
Mode of Research	Relies on factual information and expert input to improve choices. Project specific focus. Communities regarded as research subjects or "patients"	Choice improved through citizen participation and community empowerment. Focus on higher-level planning issues and broad social strategies. Communities regarded as participants and "partners"
Source and type of Information	Case studies, census and secondary data sources and measurable social indicators. Usually ahistorical and uncontextualised. Orientation towards empiricism and quantification.	Primary data collection and observation, community forums and open interviews. Attention given to historical and cultural context. Orientated towards qualitative information.
Research Aims	Efficient maximisation of net social welfare and improved research tools and capabilities.	Improved communications between communities and decision makers. Stimulates awareness. Seeks to understand social structures and process of social change.
Assumptions	Centralised social planning and management, industrial market society.	Avoids assumptions. Critical of industrial market society, encourages alternative, non-exploitive economic and social strategies.

Table 2: Comparison of the technical and political approaches to SIA

The present study of the upgrading of the Olushandja Dam adequately demonstrates the shortcomings of the technical approach for developing countries. As far as source material is concerned, settlement patterns and demographic changes were difficult to analyse in the absence of up-to-date spatial data. Responsible administrative structures were not easy to identify in the light of recent and ongoing political and legislative changes and uncertainties in Namibia. The affected environment is characterised by a subsistence economy and communal exploitation of the natural resource base as opposed to an industrialised market economy. The fairly unique political and cultural context of Owamboland limits the

usefulness of comparison with other projects and case studies which are generally lacking for SIAs in communal areas. Thus, few of the requirements of the technical approach can be adequately fulfilled. Furthermore, purposeful underdevelopment of the Owambo people as a result of South Africa's apartheid policies, make the political approach, with its emphasis on community empowerment, particularly appropriate in the context of the present study.

The ongoing debate concerning the merits of these two approaches focuses largely on quantitative evaluation techniques associated with the technical model versus the qualitative component of the political model. Despite this distinction, it is inevitable that both approaches will have to include varying degrees of both qualitative and quantitative assessment. Qualitative information provides the necessary background to explain the significance of quantitative observations which form an essential component of the decision making criteria. This argument is posed Burdge (1990) according to whom quantification of social characteristics and impacts is desirable because policy makers and planners appreciate the simplicity of numbers. However, well documented qualitative indicators provide the context within which to successfully evaluate social change.

The debate surrounding qualitative and quantitative methodologies applies not only to the type of information gathered, but perhaps more significantly, to the way in which this information is processed and evaluated. There exists a broad range of methods for quantitative evaluation generally based on the common assumption that a single best alternative exists, and that alternatives can be ordered from best to worst (Lawrence, 1993). Each alternative is associated with a set of impacts based on raw data which may be factual or opinionated, depending on the source of this data. The data is then converted into a standardised value or measure of worth or suitability. A weight is chosen for each attribute that is proportional to its importance or significance. If this weight is expressed numerically on a ratio scale the attributes may be amalgamated mathematically. While such empirical estimates can appear quite precise, demographic and economic projections have been shown to have an average absolute error in the range of 50 to 100% (Interorganisational Committee, 1994). In most quantitative methodologies assigning scores for magnitude and importance depends on the subjective views of the assessor and should not be arithmetically manipulated. Categories such as High, Medium or Low are more appropriate for subjective judgements (Fuggle and Rabie, 1992).

Examples of commonly used quantitative techniques include the Leopold Matrix, the Sondheim approach, the Batelle-Columbus method and a variety of overlay techniques. One of the most significant advantages of using these techniques is the ability to condense information on complex environmental variables into a manageable form. This process basically involves the conversion of personal ratings into composite social scores, thereby appearing objective and unbiased. But as Lawrence (1993) points out, the issue at stake is not really objectivity or subjectivity, but how well subjective judgements are substantiated.

The imposition of value judgements as an unavoidable component of quantitative techniques is particularly problematic in developing countries where the affected communities are often characterised by a unique set of cultural and social values. In such cases, it is dangerous for evaluators to assume that their values and assessment of priorities accurately reflect those of the affected public. This is not to say that a qualitative approach is not equally and more subjective, but this subjectivity is clearly acknowledged from the outset. Furthermore, the value laden component of the political and qualitative approach is associated with the process rather than the final evaluation which, ideally, is a result of community input as opposed to specialist or professional judgement, representing a shift in the balance of power from the authorities to the affected parties. According to Wandesforde-Smith *et al*, 1985 the idea that technical perfection, or at least refinement and sophistication, of the EIA/SIA process is the key to success, and that it promises progress more quickly than trying to find solutions to less malleable "people problems", afflict SIA implementation efforts.

Once the social variables have been identified and data collected, a variety of other mechanisms are available to systematically, but qualitatively move towards reasoned conclusions (Lawrence, 1993). It is possible to simplify the analysis by screening out unacceptable and unrealistic alternatives as well as common impacts or instances when the impact level is negligible in all cases. Impacts, areas of uncertainty, and alternative perspectives can also be summarised using tables and maps, and interrelationships illustrated with diagrams, scenarios and analogies (Lawrence, 1993). The focus must thus be on the discursive presentation, narrative comparisons and representation of the various aspects of the situation until the unity of an aspect can be appreciated by the decision-maker (Lawrence, 1993).

Although quantitative techniques are valued for their simplicity, they cannot reflect the dialogue, debate, bargaining, processes of accommodation and mutual understanding which should characterise an SIA concerned with community development and empowerment. The chief concern of Mr Justice Berger, responsible for the well known Mackenzie Valley Pipeline Inquiry, was to give affected communities "an opportunity to speak...in their own villages, in their own language, and in their own way (Berger, 1977 in Craig, 1990). It is debatable whether the fairness and accuracy of an SIA is contained in an orderly, comprehensive quantitative methodology or a series of presentations which reflect community opinions and means of communication. Freudenburg (1986) makes a strong argument for a qualitative approach which serves to provide relevant information for a decisionmakers judgement, rather than attempt to hide the subjective judgements of the researcher behind a single, overall numerical solution. In Freudenburg's opinion "empirical science provides no basis for combining impacts that may be as dissimilar as apples, oranges, and orangutans; efforts to add incommensurables may merely hide the value decisions that are inherent in the analyst's efforts" (Freudenburg, 1986, pp 464).

An equally strong argument can be made for the use of a quantitative methodology in an industrialised context where stakeholder can understand and appreciate sophisticated logic and mathematical models. Canter (1983) points out, evaluative techniques must be regarded as tools used to aid the impact assessor - thus there is no *right* one, it depends on the particular development situation at hand. In the case of the

communities affected by the upgrading of the Olushandja Dam, it is difficult to justify a technocratic approach, although the quantification of some factors is necessary to supplement what is basically a political and participatory approach to primary data collection and analysis. There are a number of reasons why the Olushandja Dam SIA is particularly suited to a non-technocratic approach:

- Much quantitative data has been collected through past surveys and socio-economic investigations in adjacent areas such as those by , BICON/LCE (1992), Irving *et al* (1993) and Naeraa and Solomon (1994). This information can be extrapolated to the affected environment as the Owambo communities are relatively homogenous with regard to the lifestyles and social systems (Tapscott, 1995).

- Due to the requirements of the international donor agency, the SIA was commissioned at a stage of the project cycle such that a thorough investigation of alternatives, that aspect of evaluation most suited to the use of quantitative methodologies, is essentially unrealistic and a waste of resources.

- The affected environment is characterised by complex inter-relationships shaped through historical and cultural phenomenon. This, in addition to uncertainty on the behalf of the project proponents as to the exact nature and timing of the development means that many of the impacts will be intangible and indirect - where the whole is more than simply the sum of the parts. Quantitative techniques cannot successfully address such impacts that cannot be predicted with precision.

- For a range of historical reasons, including the war and the centralised, autocratic nature of South African rule, there is not a strong tradition of community participation in decision making in the Owambo region (Department of Water Affairs, 1992). Certain sectors of the community have received some exposure to participatory appraisal through various NGO projects and self-help programs (SSD, 1991; NNRDP, 1993; CATAD, 1994). These studies have shown that there is certainly potential to involve communities and elicit public opinion using participatory techniques particularly when dealing with an important community resource such as water supply. The communities living in the vicinity of the Olushandja Dam are not significantly inhibited by poverty or ignorance and do not lack the mobilisation, knowledge and confidence to participate in plans for development.

Although there are significant advantages to the political approach to the SIA of the upgrading of the Olushandja Dam, there are also dangers and limitations associated with the approach. One such danger is that the assessment becomes "caught up" in the sociological and cultural aspects of the SIA. Time and attention can easily be diverted to complex questions and debates. Less effort is subsequently given to generating alternatives and measures that may ameliorate undesirable consequences of the proposed action, and that the decision-maker is prepared and qualified to implement (Carpenter, 1981). On the part

of the government or decision-maker it is considerably safer to define participation in technical terms, as responses by individuals to statistical surveys, rather than to encourage active involvement through PRA, thereby risking some transfer of political power from central government to localities (Rickson, *et al*, 1990b).

With regard to the present study it is tempting to agree with McAllister (1980 in Craig, 1990) that the central purpose of the social evaluation should be to help individuals - both affected parties and decisionmakers - reach personal judgements regarding the desirability of plans on the basis of the best obtainable information, rather than manipulate and condense data to produce index scores that seem to tell authorities what their attitudes ought to be. This is, in many ways, an idealistic notion. The process of community encouragement and empowerment is seriously undermined if their input is not acknowledged by the authorities due to inappropriate and idealistic goals on behalf of the researcher. This inevitable leads to a breakdown of communication with decisionmakers, and a failure on their behalf to appreciate the role of public participation. What is required is a balance between a concerted effort in the field to help people on their own terms, and an efficient and convincing means of communicating with those in authority.

The approach to the Olushandja Dam SIA is further complicated by a necessary evaluative component of the research. SIA is distinguished from evaluative research by its focus on the consequences of technological developments. According to the definition offered by Craig (1990), SIA is an attempt to predict the future effects of policy decisions (including the initiation of specific projects) upon people, their physical and psychological health, well-being and welfare, their traditions, lifestyles, institutions and interpersonal relationships. Similarly SIA is defined by the Interorganisational Committee (1994) in terms of efforts to assess or estimate, in advance, the social consequences that are likely to follow from specific policy or government actions. By contrast, evaluation research tends to take place after a project has been implemented and focuses on the intended goals of the initiative (Freudenburg, 1986). Thus SIA is a prospective planning tool, whereas evaluative research is retrospective.

The environmental problems associated with the Olushandja do not recognise or respect such discipline boundaries. A number of the issues identified, and which ought to be addressed are inevitably associated with initial dam construction, and are applicable outside of the context of the upgrading scheme. Although this aspect may be considered to be beyond the Terms of Reference for the study, it becomes difficult to distinguish between those impacts associated with the dam as a whole, and those associated the upgrading scheme only. Such a distinction would also seriously detract from the aims and value of the SIA process. The approach would, however, require the project proponent to appreciate that the social dissatisfaction associated with initial implementation of the scheme is still valid and affects the long-term viability of the scheme as a whole.

A number of aspects of the study were consequently evaluative rather than prospective. In addition to serving the best interests of the community, these evaluative aspects also contribute towards the basis of

prediction, as people's psychological and behavioural responses to dam construction provide clues to how they might react to the upgrading scheme. The Interorganisational Committee on Guidelines and Principles for SIA (1994) emphasises the value in studying the course of events in a community where an environmental change has occurred, and extrapolate from that analysis what is likely to happen. On the other hand, it is important to heed the warning from Derman and Whiteford (1985) to expect sceptical reactions to claims that are made about the ability to predict how groups of organised human beings will react to change, particularly when the assessors may not fully understand the culture or cultures participating in the project.

3 STUDY METHODOLOGY

The term "methodology" is used to refer to the general manner in which the SIA is undertaken or method of doing. It is distinguished from the term "techniques" which may be used to refer to the specific application of respective methodologies, such as the qualitative and quantitative types described above (Wildman, 1990).

Data collection for the SIA was undertaken on the basis of fulfilling the requirements of IEM to the fullest extent possible given the somewhat unconventional nature of the development project and timing of specialist input. Information was acquired by means of a preliminary site visit and a series of consultations with experts, interested and affected parties, available data banks and relevant literature was accessed and studied. Primary data was collected in the field through a series of household and key informant interviews, and a community forum or workshop. The data is tabulated, qualitatively evaluated and used as a basis for mitigatory recommendations.

3.1 Preliminary site visit and consultations

These activities formed an important component of the scoping procedure aimed at determining the extent of, and approach to, the impact assessment (Department of Environment Affairs, 1992). The study team held a series of meetings with specialists in SIA, interested and affected parties outside of the study area, social scientists, NGO representatives and organisations working in and around the study area. The consultations were approached with several aims in mind:

- To enhance the social assessment team's understanding of the Owambo people, their cultural and social structures, way of life, interaction with their natural environment and attitudes towards investigative social studies.
- To clarify the technical details and motivation for the upgrading scheme.
- To assist in the development of an appropriate approach to the collection of field data.
- To inform the relevant authorities and interested parties of the proposed SIA and to ensure that the study team's research would not overlap or interfere with other research that is, or has been, undertaken in the area.
- To assist in the identification of all parties that may be affected by the upgrading scheme, and gauge opinions and attitudes towards the scheme.
- To identify the relevant administrative structures and procedures, and clarify legislative requirements.

A list of all those consulted as well as the minutes of these meetings are contained in appendices to the baseline document.

A preliminary site visit provided the social assessment team with some indication of the number and distribution of the potentially affected communities. It also enabled the team to assess the condition of existing infrastructures and determine the stage of development. Permission was obtained from the relevant political councillor to undertake research in the area under his jurisdiction.

Insights gained during the preliminary site visit and consultations formed the basis of several important decisions on behalf of the study team:

- To proceed with a focused, qualitative and participatory approach to data gathering in acknowledgement of the cultural and political homogeneity amongst the Owambo people which enables the extrapolation of data collected in adjacent areas.
- To restrict the activities of the study team to an area extending 10km to the east, west and south of the dam, and as far as the Angolan border to the north. This was considered reasonable in terms of encompassing the geographical extent of impacted communities and their livestock and time available for fieldwork. For further details in this regard, refer to the baseline document.
- In the absence of up-to-date spatial information reflecting the exact number and distribution of the households in the study area, it was decided to use a non-probability sampling technique in the collection of data from individual households.
- A number of social assessment variables were identified. These point toward change in the human population, communities and social relationships resulting from the development project and are as follows:

    - Settlement patterns and characteristics, their development and social and biophysical determinants.

    - Tenure systems including patterns of natural resource and land-use, crop production and pastoralism.

    - Social structures including attitudes, perceptions, gender roles, family characteristics and friendship networks.

    - Health and well-being referring to causes of ill health and access to community health services.

    - Community resources focusing on availability and access to water and the utilisation thereof.

These variables pertain to the survival and continuity of the affected communities and must be assessed against the historical and cultural development of these communities. The social impact assessment variables form the basis and focus of the investigation. They are closely associated with foreseen impacts.

3.2 Secondary Information

Accessing available information about the affected communities before conducting field work takes on particular importance in developing countries when the historical and cultural background of these communities differs from that of the assessors. Historical accounts, descriptive literature, government records, relevant legislative and administrative documents, parallel studies conducted elsewhere, maps and data collected for other purposes were important sources of secondary data for the present study. Information obtained through these sources related to the history of the project and affected area, the technical characteristics of the development, regional plans, socio-economic data, relevant legislation as well as community means of subsistence.

It was consequently possible to rely considerably on existing data supplemented by appropriate wet and dry season field observations, to gain insight into people's lifestyles, social interactions, pastoral and agricultural practises and the degree of people's dependence on the natural resource base. In this way competitive data collection was avoided and questionnaires could be constructed so as to avoid impersonal interrogation aimed at eliciting factual information which could be derived from previous studies. This notion is supported by Burdge (1990) who is in favour of the compilation of regional databases which can be supplemented with additional site-specific information, if the region in question is experiencing rapid growth through numerous developments and is somewhat culturally homogenous.

A number of problems were encountered with the secondary data sources. The most significant of these was the lack of up to date spatial information. The aerial photographs on which available topographic maps were based dated back to the 1960s. This problem was to some extent alleviated when a aerial photographs of the study site were especially flown in response to a request by the study team. Unfortunately, these photographs only became available after the field work had been conducted and consequently could not be used in the generation of a suitable sample. Population data obtained from the 1991 census was also somewhat outdated and non-specific. Much of the data is based on the old traditional areas which are unrelated to the new regional electoral districts. There are also fairly sharp distinctions and poor communication between government sectors and departments which often made it difficult to locate the required documentation. Some of the relevant administration, particularly that relating to the water utility company, had yet to be approved by the cabinet and was consequently unavailable for review before fieldwork was undertaken.

There was a noticeable and unfortunate information gap relating to the fishing and poaching policies of the Department of Nature Conservation and how these may apply to the affected environment. The relevant authority in this regard could not be contacted throughout the course of the study.

Nevertheless, an adequate amount of secondary data was made available to the social assessment team by various government and non-government organisations and private consultants. Information was also obtained from the libraries of the Department of Water Affairs, the Geological Survey Department of Namibia and the University of Cape Town.

3.3 Primary Data Collection

Three approaches were used in the collection of primary social data, namely, key informant interviews, household interviews and a community forum or workshop. Community liaison and participation formed an important component of these methods. Despite this emphasis, the distinction between SIA and the public participation process must be appreciated. According to Burdge and Robertson (1990) SIA represents a systematic effort to identify, analyse and evaluate social impacts of a proposed project on the individuals, social groups or communities prior to decision making so that information derived from the SIA can influence decisions. The goal of a properly executed SIA is consequently to identify and understand the consequences of change for human populations, given various impact events (Burdge, 1987).

Public involvement, on the other hand, constitutes a means of educating the impacted community. It provides people with an opportunity to express their own opinions and ideas and assists in the identification of problems associated with the proposed project, as well as the needs and values of the impacted population (Burdge and Robertson, 1990). It can also act as a means of increasing the proponents credibility and lessening public resistance to change by providing them a voice in the decision making process (Burdge and Robertson, 1990). Public involvement forms a crucial component of the political approach to SIA and serves to ensure that the data collection process is an interactive rather than extractive activity. According to Gagnon *et al* (1987), participation provides an avenue for empowerment of local communities. As is the case with the SIA process, public involvement should act as a means to an end as well as an end in itself.

Key informant interviews, questionnaire surveys and community forums are public involvement techniques that, used either singularly or in combination, fit within the SIA process (Burdge, 1983). All three techniques were employed in the study.

3.3.1 Key Informant Interviews

Key informant interviews are a useful tool for involving individuals able to provide the SIA team with information and insights into the population, community, agricultural and perceptual issues being studied. Such interviews were conducted at a national and local level. The latter in the study area, and the former with key national and regional government officials. The chief purpose of the key informant interviews was to validate (or invalidate) and supplement data acquired through household interviews. Discussions and choice of informants were aimed at achieving a balanced view of the development scheme.

Local key-informant interviews were directed at tribal and political authorities, school principles and teachers, health and extension workers, church leaders, fishermen and market garden representatives. National key informants included spokespeople for the Department of Water Affairs, the Ministry of

Lands, Resettlement and Rehabilitation, Ministry of Environment and Tourism, the Directorate of Veterinary Services, Ministry of Education and the Ministry of Agriculture, Water and Rural Development. Researchers and social scientists with experience in Owamboland also acted as useful key informants.

In all of these interviews emphasis was placed on informal, two-way communication. Guidelines rather than formal questionnaires were compiled to focus interviews with local key informants on the appropriate social impact assessment variables. These are contained in Appendix 5.2 of the baseline report.

3.3.2 Household Interviews

Information and insights acquired through a series of household interviews in the study area, conducted over a period of 10 days, acted as the primary data source for the identification and mitigation of impacts. An interview can be simply described as a "conversation with a purpose" (Fowler and Mangione, 1991, pp 11). There are however, many different types of interviews and the specific purpose of the conversation determines which procedures are appropriate. Considerable attention was directed by the study team toward designing a suitable approach to the household survey.

A standardised survey is ordinarily characterised by two components. Firstly, the substantive part of the conversation consists of questions and answers. And secondly, the participants have defined non-overlapping roles as askers and answerers of questions (Fowler and Mangione, 1991). An important assumption in this regard is that the respondent is familiar with the concept of an interview or survey. Such an assumption is not always possible in developing contexts where respondents have not been exposed to many factors relating to interviews which may be taken for granted when dealing with western population groups. In developing countries a significantly different and carefully planned approach is required which is largely dependent on the attitude and sensitivity of the assessor towards distinctive social and cultural characteristics of the impacted communities.

For example, it is inappropriate to approach Owambo residences without seeking permission from the traditional authority in the area under his jurisdiction. The manner in which one enters a homestead and approaches the occupants is also an important consideration. Furthermore, one must be aware of which type of greetings are appropriate for specific times of day and people of particular age and sex. These considerations constitute a sign of respect towards those who are to provide necessary input into the decision making process. They also facilitate informal interaction and alleviate suspicion on the part of the respondent.

The household interviews served as both a public involvement and data collection tool for the SIA. Maclaren (1987) believes the major strength of households surveys as a public involvement tool is that the information obtained is representative of the general population and includes the views of the so-called silent majority.

The aim of the interviews was to acquire general information about people's concerns and priorities as a sound basis for prediction and evaluation of the social consequences of the upgrading scheme. An open, semi-structured questionnaire was designed which sought people's opinions, perceptions and reasons explaining their behaviour with regard to water utilisation and resource use. It was considered inappropriate to present people with various alternatives and management strategies. This was partly because the decision to upgrade the supply scheme has already been taken, and because it was considered necessary to instill a fear of inundation and risk the spread of disinformation among the communities, particularly since precise details regarding fluctuating water levels were unavailable at the time of research. A total of 80 households were interviewed in the study area on an availability basis in the absence of adequate spatial data. The survey was conducted in three concentric zones around the dam (Zone A, B and C) in order to compare communities with gradients of availability or access to water from the dam, as compared to the other water supply infrastructure (Fig. 7).

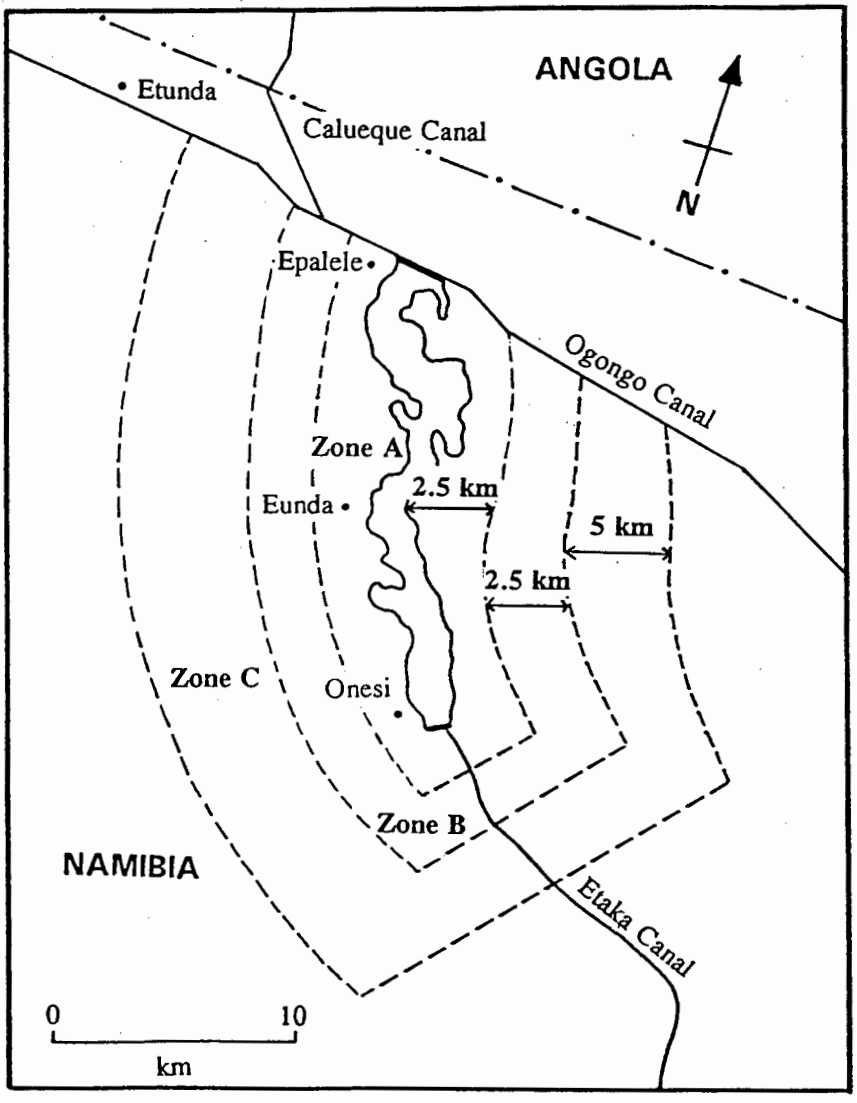


Figure 7: The study area divided into Zones A, B and C

The qualitative and informal approach was designed to enlist respondents as collaborators in the research by explaining to them what was required and asking them to provide the necessary information. The questionnaire covered all the identified social impact assessment variables, but additional follow-up questions and discussion were encouraged during the course of the interview to maximise the amount of information acquired and ensure that all potentially relevant issues were covered. In the evaluation of this type of interview it is the role of the researcher to analyse narrative answers and reach conclusions about the respondents that could not always be articulated during the interview.

Woman and the elderly were targeted in the survey. Old people were considered more reliable informants regarding social conditions prior to dam construction. Previous research has also shown that the elderly suffer most from social disruption associated with involuntary relocation (Burdge, 1990). Woman were identified as most susceptible to the negative impacts of the upgrading scheme as their domestic role in the homestead makes them responsible for water collection and utilisation and concerns them with the health and well-being of the children. Research undertaken in southern Africa by CATAD (1994) indicates that women are generally more directly affected by the impacts associated with development projects and yet these seldom operate in favour of women.

Recent studies in northern Namibia have shown that women frequently outnumber men by more than two to one (Department of Water Affairs, 1992, Irving *et al*, 1993). Men often leave the homestead in search of formal employment, leaving the women to run the farm households. Women are consequently more aware than men of the most urgent needs for infrastructure and services and may also be more committed to enhancing the benefits of a project (Moser, 1989). It was consequently deemed important for the study team to obtain the views and perceptions of at least as many woman as men. House to house visits ensures that women are informed and given the opportunity to participate in the information gathering process.

There are distinct advantages and disadvantages to using an open, qualitative interview technique. For example, open-ended discussion and narrative answers tell the assessor more about what is going on in the mind of the respondent but do not provide information amenable to quantitative analysis as do closed response answers (Fowler and Mangione, 1991). The data is consequently more difficult to prepare and present to the decision-maker. Comparison between information collected by research teams in the study area is also complicated as the results are often inconsistent and contradictory. There are considerably more sources of error related to unstructured or semi-structured interviews. Perceived errors in the household survey around the dam are listed below. Some of these are standard errors characteristic of all surveys, others are more specific to the present study, but may easily be encountered in other SIAs in developing countries.

- Sampling Error

  Any survey estimate based on a sample is subject to this type of error stemming from the possibility that the sample may not accurately represent the views of the population from which it was drawn. The degree of error depends on the sample size and the way the sample is selected (Fowler and Mangione, 1991). The significance of error depends on the way the data is manipulated during subsequent analysis. The sample used by the SIA team is indicative and although the size of the sample was thought to be adequate, its representativeness cannot be statistically proved

- Questions as sources of error

  Questions, particularly of a qualitative nature, vary greatly in the accuracy of answers they elicit. There always is potential for shifts in emphasis and meaning between the responses to open ended questions and what is recorded by the assessor. This problem is compounded by the need to use translators as had to be done for the current study. Slight variations in the translation of questions can elicit very different responses for the interviewee. Nuances and subtle changes in tone and reaction can also be lost in the translation. This was regarded to be the most significant source of error and cause of inconsistencies in the field data.

- Interviewers as a source of error

  The way in which the interviewer interacts with the respondent can influence the amount and type of information elicited during an interview. This is particularly so when the assessors are noticeably "outsiders" distinct in their style of dress, manner of speech and ethnicity. When the SIA is being conducted in rural areas in developing countries it is seldom possible to communicate with the prospective respondents prior to the interview and inform them of the intended household visit. It is inevitable that respondents may be initially suspicious of the purpose of the study and respond hesitantly or with inhibition. This problem is exacerbated in a post-war context and where tension emanating from recent election campaigns are a stumbling block to trust and confidence.

Several precautions were taken prior to fieldwork to minimise sources of error. Intensive briefing sessions were held with members of the study team and the translators to encourage a uniform approach to the household interviews. The difference between interpretation and translation were impressed upon the translators who had limited previous experience. Despite this drawback, the translators were familiar with Owambo customs and traditions, and assisted greatly in reducing the perceptual gap between the study team and the community. Those members of the SIA team responsible for recording responses to open ended questions were to do so verbatim, as far as possible, without the use of paraphrasing and summaries. This is regarded by Fowler and Mangione (1991) as the rule for recording open-ended responses to opinion or attitude questions.

Interviewer related error was mitigated by attempts on behalf of the SIA team to involve themselves in the activities of the respondents. This generally entailed informal interaction over a cup of Mahangu beer or assisting in the tilling of the fields. The only way possible to inform people in advance of the activities in the study area was through the headmen and by word of mouth.

Not all the questions in the interview questionnaire were entirely open-ended. Some required more precise answers in order to contextualise opinions and perceptions or verify information acquired through secondary sources. An example of the questionnaire is contained in Appendix 5 of the baseline report. Interviews tended to take 1 to 2 hours and were most often conducted under a tree in the fields comprising the *eputa*.

3.3.3 Community Workshop

The primary purpose of organising a community meeting or workshop was to elicit additional information and opinions about the Olushandja Dam that may not have been expressed or articulated during the household interviews. According to Ross (1990), assessors and local communities may have very different perceptions of what constitutes a meaningful and significant impact. The community workshop thus also served to ensure that events and issues considered important by the people were not inadvertently missed or marginalised.

Rickson *et al* (1990b) identifies some of the advantages associated with information gathering on a group as opposed to an individual basis. Firstly, active groups are more likely to express different sides to an issue and how decisions are apt to affect them. Additionally, social sectors and individuals, particularly women, who are unlikely to participate on a routine basis are drawn into conflicts and contribute information regarding the nature of their values and interpretation of the project. Debates and arguments generated by group interaction may improve both the quality and quantity of information gained (Rickson *et al*, 1990b). Community gatherings also serve to reveal social organisational structures as well as the fact that most societies already have a series of concepts and ideas of what constitutes a good life or moral behaviour, why things are the way they are, and how things may or may not be changed (Derman and Whiteford, 1985). This was certainly found to be the case in the experience of the SIA team.

The public participation technique employed in the meeting was drawn from a fast developing body of methodology, specifically aimed at developing countries, called Participatory Rural Appraisal (PRA). An important aspect of PRA, as far as SIA is concerned, is that it mitigates government opinion that they represent the views of the population and that no additional mechanisms are required to solicit the views of the intended beneficiaries or impacted communities. Implicit is the assumption that the public will not have appropriate vehicles to express their thoughts or organise their response to projects they will be affected by (Derman and Whiteford, 1985). Such an assumption would have been typical of past governments in Namibia. PRA techniques are designed to provide the previously disempowered public with just such a vehicle.

The main feature of PRA is its unequivocal recognition of the fact that people perceive and understand reality in different ways and consensus arrived at concerning a topic reflects their assessment or opinion (CATAD, 1994). Part of the process involves the extension of formal procedures into less formal settings, where avenues for community influence are greater (Gagnon, 1993). Ideally PRA is a process whereby affected individuals are involved in the design and implementation of a project aimed at improving their quality of life on a relatively long term basis. But PRA methods are also transferable and can be used in many fields of application. There are a number of PRA techniques which may be usefully employed as part of an SIA (Tapscott, 1995). The technique used in the present study is called land-use mapping, as is described by CATAD (1994). This PRA activity encourages people to draw their houses or villages in relation to important sites and environmental resources. The drawing acts as a common language for communication between the assessor and the potentially affected individuals and communities.

The community workshop involved the organisation of attendants of a community meeting arranged by a local headman, into four sub-groups comprising between 10 and 30 people. Ideally groups should be restricted to 5 to 8 people, but this was not logistically possible in terms of available research tools and resources. Maps were then drawn by the people using large pieces of paper of chalk provided by the study team. The maps revealed the accurate spatial perception of the people with regard to their living areas, and spatial relationships between various aspects of the affected environment, particularly water sources and infrastructure. Some individuals were enthusiastic and spontaneous in their involvement with the construction of the map. Others were somewhat reticent and inhibited. This reflects a natural and expected reaction of any group to a new and unfamiliar concept.

The maps were useful in that they were illustrative of issues and resources most important to the community. The process itself involved a perceivable shift in the balance of power from the study team and political and traditional authorities who began the meeting with a formal address, towards the affected communities who became the central figures in the mapping process. Furthermore, it heightened the people's awareness of the nature of problems and their causes, regarding living conditions and biophysical resources.

Although the land-use mapping technique generated and conveyed more information than a conventional meeting might have done, the process was, nevertheless, indicative of a number of practical problems associated with a high degree of community involvement and interaction. For the Olushandja Dam SIA, these problems related to the following:

- Uncertainty about the exact nature and timing of project actions made it difficult for the SIA team to convey these details to the community without instilling fear or raising expectations. The mapping exercise was consequently fairly general and there were few issues for the communities to focus or concentrate their efforts on.

- Although most group members participated in the process there was a tendency for powerful figures, generally orientated to specific self-interest concerns, to dominate the proceedings, thereby inhibiting or stifling potentially valuable contributions by other group members.
- With only a single translator for each groups, comments and conversational details are lost, particularly when the participants become involved in arguments and debates concerning the spatial detail to be depicted. This problem is to some degree mitigated by the fact that the details captured in the map, to some extent, represent consensus among the participants.
- Spontaneous groupings tended to reflect a gender bias. Of the groups formed one comprised males only and another was predominantly female. Such desegregation on the basis of gender reflected the different roles played by men and women in society and consequently in community participation. The male group showed a greater reluctance to participate in the mapping exercise.
- Complex logistics owing to the unexpected large number of participants hindered the process and prompted participants to lose interest.

Despite the value of the exercise in terms of community participation and empowerment, these ideals are somewhat undermined by the lack of immediately evident or significant benefits of the project. The community are unlikely to perceive a short term response by the government to the concerns expressed during the information gathering component of the SIA. According to Gagnon *et al* (1993), SIA strategies aimed at negotiating and mobilising local populations as a means of challenging conventional power relations in decision-making, involves an appreciation on behalf of authorities, of the role of community empowerment in planning that influences, not just quality of life, but in many cases, community survival and the viability of future livelihoods in rural areas.

The need to move from a professionally dominated SIA process to one characterised by a higher degree of community participation may increasingly be recognised by planners, but effective means of accomplishing this end have seldom, as yet, been implemented (Burdge, 1990). Public involvement in the form of the community workshop and household interviews in present study do not represent true participation or empowerment since community opinion is unlikely to have a significant impact on the decision to upgrade. Furthermore, the involvement of individuals and communities was event based rather than process based i.e: people were not and will not be integrated from the conception phase through the implementation phase of the project. Instead their contact with the assessment team and input to the decision making process will be limited to one or two occasions. The study does, however, contribute towards increasing community awareness of their ability to define their problems and expectations, given an appropriate opportunity and vehicle for communication. This awareness will inevitably be coupled with certain expectations, on behalf of the local population, to be consulted in the future on developmental issues that affect them.

3.4 Study results

The way in which a researcher views the information collected for a particular EIA or SIA, depends primarily on the type or source of the data. Williams (1991) argues that data recorded in what may be termed literate cultures of the developed world, are no longer raw as might have been the case prior to industrial and technological revolutions. Higher levels of education provide individuals with a conscious objectivity in their interpretation of events. This may be due to historical consciousness and awareness, or a desire to impose logic on the telling or description of a happening or observation. Primary information in a developed social context may be subject to a far more intricate conceptual framework which governs the way it is transmitted to the assessor. It is arguable whether such data should be treated as primary, raw data, or secondary information that has already been subject to a degree of interpretation. Consequently, approaches to data collection in western cultures will often focus on ways of eliminating bias and achieving a high degree of objectivity.

Predominantly oral cultures may not be motivated by the same set of instincts. This is not to say that data collected among oral cultures are entirely without prejudice and distortion. It may, however, be easier to interpret causes of bias since these are often derived from past events or historical truths as opposed to an internal process of interpretation. On the other hand, in dealing with true primary data such as that collected for the present study, a greater responsibility for organising and communicating of that information lies with the assessor.

After a review of relevant literature and other secondary sources, the perception of the assessor may well be governed by what one expects to see, rather than actual observations. Prior to fieldwork, an hypothesis is generally determined by the intended analysis of the subject, usually contained in the terms of reference for the SIA. The field inevitably serves as a laboratory to test an hypothesis (Williams, 1991). In this regard, an assessor in a developing context, that may be a distinct outsider to the culture being investigated, has to be consistently prepared to change his or her perceptions on a situation. In using a qualitative approach, the assessor is more interested in the instinctive reactions and opinions of the affected community as opposed to factual data. The reliability of the former type of information is far less questionable than it would be in western cultures. During household interviews for the present study, a respondent was seldom able to give the interviewer his or her precise age but the study team felt relatively confident in identifying the fears and concerns of the community.

Detailed summaries of the results of the study are provided in the Appendix to the baseline report. In each interview respondents were given opportunities to add to the information to that concerning the social assessment variables which formed the basis of the questionnaire. This, in combination with the spontaneous identification of problems during the community meeting, assisted the study team in expanding and sorting the social assessment variables, thereby defining those issues most significant to the community. The approach also assisted in identifying appropriate solutions to environmental problems.

During interviews with households and community leaders, and as a result of the community workshop it became apparent that the main concerns of people in the study area related to the following:

- Health consequences of utilising the water in the canals and dam, and the inadequacy of health facilities;
- Agricultural productivity and the effect of crop pests;
- Fishing in the dam and control of fishing activities;
- Livestock grazing, or lack thereof, and cattle disease.

Aspects of the questionnaire dealt with each of these in the categories of health, agriculture, livestock and fishing. Concerns inadequately dealt with in the questionnaire included the effect of the dam on movement and visiting patterns. The need for a bridge was strongly expressed during the community workshop. Favoured sites for the location of the bridge are indicated on the maps drawn at the community workshop and reproduced which are reproduced in the appendices to the baseline report. The attention of the study team was also drawn to the negative impact of the dam on grazing. Community members complained of a lack of potable water supplies, particularly for the benefit of schools and clinics. It was suggested during he community meeting that a pipeline be built on the eastern side of the dam. Contrary to expectations of the study team, it was realised that the dam had not induced settlement in the study area. Although most respondents were happy that the dam had been built, it would seem that the presence of infrastructure, including potable water supply, and social support networks are more powerful determinants of population distribution.

Household interviews were modified in accordance with issues identified during the study to determine which of these held widespread significance for the people. To compensate for perceptual difference between themselves and the community, the study team made a concerted effort to record as many of the added comments and insights made by respondents. As far as possible, the team also allowed for their pre-conceived perceptions and expectations to be changed by their on-site experiences. Despite these empathetic attempts, the result of the study remain an interpretation based on a value system that differs from that of the affected community. As this cannot be changed, it must be clearly acknowledged.

4 THE AFFECTED ENVIRONMENT

A detailed description of the study area and its geographic characteristics, distinguishing between the biophysical and socio-economic environmental factors, is provided in the baseline report. For the purposes of this study these two aspects will be considered in conjunction. An SIA, in the developing context, typically focuses on the interface between socio-economic and biophysical attributes of a geographical setting - on what may be regarded as the human environment. This is defined by the NEPA regulations as follows:

> "Human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment" (NEPA 42 USC 4321-4544, Craig, 1990).

The concept of a human environment is particularly relevant to the assessment of impacts on a subsistence community where social welfare issues and environmental quality are inseparable. Some authors would go as far as regarding SIA and EIA as synonymous in a developing context (Brown, 1990). This idea is supported by the regulations of the US's Council of Environmental Quality: when an EIA is prepared "and economic or social and natural or biophysical environmental effects are interrelated, then the environmental impact statement will discuss these affects on the human environment" (40 CFR 1508.14. Interorganisational Committee, 1994). According to Rickson and Rickson (1990b) environmental management is essentially a process of controlling or administrating how people and their institutions relate to or use their natural environment.

In an area such as former Owamboland where at least 600 000 tradition bound rural communities are entirely dependent on their environment to meet their basic needs for food, shelter, fuel and water there is clearly a requirement for an anthropocentric emphasis in any kind of environmental impact evaluation. This emphasis must nevertheless be balanced by a consideration of the consequences of impact on the biophysical systems on which people depend. The following discussion of the affected environment focuses on the crucial interrelationship between people and their natural surroundings. The relationship is typical of many of the communities detrimentally affected by large scale developments justified on the basis of national benefit.

4.1 Historical perspective

SIA and EIA reports tend to be ahistorical. Derman and Whiteford (1985)have suggested that the reason for this is partly because questionnaires are not very effective instruments for gathering historical information, but more importantly, because historical bias can reflect a theoretical perspective that is insensitive to issues of social inequality. This is particularly relevant to countries subject to previous colonial administration. According to Williams (1991) such political conquests and conflicts have been the major causes of historical distortion in most parts of the world. A historical perspective is

nevertheless crucial on behalf of researchers operating in unfamiliar or foreign circumstances.

Both the recent political history as well as the cultural development of the Owambo nation are important in providing an overall perspective of social change. A knowledge of historical events and traditional practices may elucidate the relationship between people and their environment. Information about past conflicts and cooperation may also be useful in predicting people's attitudes and reactions to development projects and is crucial to ensuring the appropriateness of compensatory and mitigatory measures. Furthermore the timing of fieldwork and research must be considered in the context of general political development of a region as this has implications for the reliability of sources from which the data is to be collected (Williams, 1991). Derman and Whiteford (1985) and Henry (1990) argue strongly that social analysis and SIA in particular require a historical perspective.

The history of the Owambo people is not well documented and earlier accounts are subject to colonial bias. A recent-post independence study by Williams (1991) provides a thorough account of the development and decline of the Owambo Kingdoms, based on oral history collected from Owambo informants. Many of the Owambo customs and traditions have long been undermined by foreign influences accompanying external contact in the form of trade, Christianity and colonialism. Nevertheless, people's priorities and perceptions of ownership and settlement patterns can best be understood in the light of past customs and beliefs.

4.1.1 The Origin of the Owambo nation

The Owambos are a Bantu-speaking people, belonging to the south western Bantu language group. There are a number of theories regarding the exact origin of the Owambo people. The most often quoted theory is that of the Great Lake of Central Africa from where they migrated to an area near the Kavango River (Department of Foreign Affairs, 1971; Williams, 1991). The forebears of the present Owambo people are thought to have subsequently moved westwards, while others remained along the Kavango River and, in time, became the Kavango people (Department of foreign Affairs, 1971).

Indications are that Owambo migration was a slow process in response to population pressure and wars. According to Williams (1991), oral evidence suggests that people also advanced in response to information collected by hunting expedition groups regarding the fertility of an area and the availability of water and game. The creation of permanent settlements in north central Namibia was probably prompted by the ecology of the region. Originally the area occupied by the Owambo people was between 16° and 20° latitude and 14° and 18° longitude including the entire drainage area of the Cuvelai River (UNICEF, 1991). The people and the ecological region were artificially divided by the creation of a political border between Angola and Namibia in 1890 (Portuguese/German border agreement) (Marsh and Seely, 1992).

Early patterns of settlement in semi-desert Owamboland are a reflection of the way people adapted to eco-regional parameters such as the availability of land for cattle grazing and cultivation and the availability of water. Formal political organisation was achieved through the formation of kingdoms as groups began to concentrate and form social and ethnic relationships. The most densely populated settlements were on the floodplain of the Cuvelai River and the one in five year floods (*Efundja*) became a crucial component of people's livelihoods, providing fish, renewing vegetation, enriching the soil and recharging underground water reserves. Where the floodwaters drained into pans, salt strata formed which became the source of an important bartering commodity. Centralised leadership emerged among settlements as one family or clan imposed its will upon others.

Eight subgroups or "kingdoms" are still recognisable today although since independence Owamboland has been divided into a number of electoral regions by the revision of the Magistrates' Court Act, 1944 (Act 32 of 1944). These boundaries have little relevance to the communities who still refer to the traditional areas of Uukwanyama, Ondonga, Uukwambi, Ombalantu, Ongandjera, Uukwaluudhi and Eunda. It is difficult for outsiders to distinguish the boundaries of the kingdoms as there are no border marks or fences (Williams, 1991). In the past there might have been a forest belt between the kingdoms, but respect for the borders stemmed from religious rituals performed to sanctify and protect them (Williams, 1991).

The religious element was an important part of the ideological basis of the respective kingdoms. The king himself was regarded as the spiritual link between the living and the dead and presided over all religious functions of the kingdom. The king was expected to play a role in increasing fertility and providing rain, but was distinguished from the supreme god, Kalunga, a supernatural figure associated with ancestral spirits who possessed power over fertility, rain, the growth of cultivated plants and a rich harvest (Williams, 1991). Ritual activities were associated with fire, rain, initiation and various journeys undertaken at different times of the year. With the exception of initiation ceremonies in some remote parts of Owamboland, most of the ancient ritual practices have died out due to the expansion of Christianity.

Numerous wars were waged between the kingdoms as various clans or groups dominated at different times throughout the pre-colonial history of Owamboland. The wars were not aimed at acquiring territory, but at capturing property mainly in the form of cattle. Land is nevertheless a very important concept and originally the central component of inheritance. The king was aware that by controlling the land he ultimately controlled everything on it. This control is not equated with the concept of ownership. Land is still a communal property over which the king presides and grants life interests of a usufructuary nature to individual clan members for crop cultivation (Department of Foreign Affairs, 1971). The king does not have control over the production of individual homesteads, but receives tributes in the form of cattle and crops which used to form the basis of the kingdom's wealth. In communities when there have been no kings (Ukolonkadhi and Ombalantu), land is regulated by the headman either directly or through ward headmen or sub-headmen.

4.1.2 Pre-Independence Owamboland

After the defeat of the Germans by South African troops during the First World War, South West Africa became a League of Nations "trust territory" assigned to the Union of South Africa. Over the next 60 years local inhabitants of the northern areas were regarded primarily as a labour reserve for commercial undertakings, and copper and diamond mining developments in the south. In 1947 South Africa formally announced to the United Nations (UN) their intention to annex the territory (McIntyre and Atkins, 1993). This idea was merely opposed by the UN until the 1960's when they formally tried to rescind the mandate and establish Namibian independence. (BICON/LCE, 1992). Such legal attempts were ineffective and South Africa retained their occupation of Namibia, declaring Owamboland a "homeland" in 1963. The self-governing status served to promote unity among the different Owambo groups who now had to share representation in a single administrative structure. As with homelands elsewhere the development of infrastructure and services was restricted.

The year 1966 saw the first armed uprising of the Namibian people against the South African administration under the leadership of the South West African People's Organisation (SWAPO). The membership of SWAPO was drawn almost exclusively from Owambos. The independence of Angola in 1975 affected what became known as the Independence War in Namibia as SWAPO guerillas received support from the MPLA (Popular Movement for the Liberation of Angola) while South Africa backed the UNITA (National Union for Total Independence of Angola) forces of Jonas Savimbi. The situation was aggravated with the arrival of Cuban troops in Angola in support of the MPLA which posed a further threat to South African forces in Namibia (McIntyre and Atkins, 1993).

Namibian independence was supported by the majority of the UN General Assembly. Economic sanctions were, however, repeatedly vetoed by the western powers of the security council who had vested interests in the multinational companies which dominated Namibia's economy with generous assistance and support from South Africa (McIntyre and Atkins, 1993). Economic factors thus became a major obstacle to Namibian independence which would lead to huge financial costs for South Africa in lost exports.

War continued uninterrupted for 14 years and played a major role in the pattern of further social and economic development in Owamboland. The development of infrastructure mainly in the form of roads reflected the immediate needs of occupying forces rather than the requirements of planned development in the region. Provision of water and sanitation also tended to cater for military needs rather than those of the local population (Lund, 1992). The growth of towns and urban economies was stimulated and patterns of agricultural production in rural areas were to some extent altered as people moved to district centres in response to job opportunities.

During this period the Calueque Dam suffered serious damage as South African troops struck at SWAPO bases in southern Angola. The Olushandja Dam pump station was also damaged by bomb attacks.

Consequently the transfer of water form the Cunene River to Namibia ceased with the exception of a short period between 1985 and 1988 (Lund, 1992). In early 1990 the Angolan government authorised Namibia to reinstate the pumping operation.

Since independence Owamboland is centrally controlled by the national government of Namibia. The traditional leadership structure is still in place in the rural areas of Owambo, however, the role of the king has been minimised to that of a figurehead. He is nevertheless a respected authority his headman having jurisdiction over land through the eyes of the people. It is still necessary for anyone who enters areas of Owambo with the purpose of talking or intermingling with the people to seek permission form the king or headman of the area or ward.

The new political boundaries set up prior to the 1992 regional elections divide Owambo into several constituencies bearing no resemblance to the original kingdoms or traditional authority areas as they have since become known. Local administration now comprises elected regional political councillors. As discussed previously, there is still some uncertainty as to how the councillors will interact with the traditional leaders.

The President of the country takes a personal interest in economic and social developments in the region as it is his birthplace and a political stronghold for the SWAPO regime. Political relations with South Africa and Angola have improved considerably although the internal conflicts in Angola are yet to be resolved. Under the prevailing peaceful political circumstances Namibian authorities are concentrating their efforts on the successful development and provision of services in Owamboland.

It is clear that the historical development of Owamboland would have a significant influence on current patterns of social behaviour and interaction. The pre-colonial development of the Owambo kingdoms, the impacts of colonial expansion, political conflict preceding the independence of Namibia and subsequent changes since the introduction of a new administration are all reflected in the dynamic integration of traditional practices and western influences in former Owamboland. An awareness of the variety of factors and influences contributing to social patterns and development of the Owambo people is crucial to understanding the needs and priorities of communities and the manner in which they should be approached.

4.2 Owambo Land-Use System

The land-use system of north central Namibia is and agro-silvipastoral system, based on a crop cultivation, livestock (mainly cattle and goats), and a mix of multipurpose indigenous trees and shrubs. In the past this system has successfully enabled the Owambo population to cope, despite having been subject to decades of warfare and rapid population growth (Kreike, 1995). The balance between these components is, however, detrimentally affected by extensive deforestation and land degradation. Reliance on the crop component is increasing as the natural resource base is exploited at an unsustainable rate. The various components of the agro-silvipastoral system shall be discussed in turn.

4.2.1 Tenure arrangements

Traditionally land in Owamboland is not sold but leased with the leaseholder being expected to pay a number of cattle as tribute to the king or headman for the right of usufruct (Williams, 1991). Since the introduction of a monetary economy, land may also be paid for in Namibian dollars. The "cost" of a piece of land depends on its size and whether or not it has been cleared of indigenous shrub. Land is not inheritable, the rights to a piece of land end with the death of the leaseholder as assets acquired through customary means are not recognised as part of a personal estate. The usufruct thus has to be renegotiated and new payments made to the headmen. A major problem in this regard is the fact that women are required to immediately relinquish land upon the death of their husbands. After independence attempts were made by the government through policy statements to encourage the practice of inheritance of land by widows and male heirs (Kreike, 1995). It will take time for such an innovation to be accepted by the traditional authorities especially when it is not in their best interests.

Allocated properties vary in size - on average 1 to 6ha, seldom exceeding 10ha (Naeraa and Solomon, 1994). Settlement tends to be scattered in rural areas and systematic patterns of location are difficult to identify although groupings of homesteads known as *omakunda* do form and can operate as villages (BICON/LCE, 1992). An individual homestead is divided into two land-use areas: the *egumbo* is the household living area comprising several dwellings surrounded by a wooden arcade. The term *epya* refers to the cultivated field surrounding the *egumbo* which may be located in the centre or to one side of the *epya* (Irving *et al*, 1993). The homestead, once established, is a fairly permanent structure. The first generation of a family usually remain in one place while younger family members get married and set up home in a different part of the community or move elsewhere to more productive land (Irving *et al*, 1993).

Land that is not under cultivation is called the *eputa* and is reserved for grazing and resource utilisation on a communal basis. With increasing population pressure communal land is being extensively exploited and people are beginning to lay exclusive claim to water sources and woodland areas. According to Marsh and Seely (1992) and Tapscott and Hangula (1994) large areas of communal grazing have been fenced off by the wealthiest and most influential Owambo farmers. Although smaller and less affluent farmers are opposed to this practice, there is no prohibitive legislation and permission is still granted through the headman who accepts extra payment from the wealthier farmers. The cost of the land is still nominal by comparison to the market related prices of commercial farmland in the south.

The land tenure issue is a controversial among government authorities since there is no official legislation allowing the headman to accept money for land (Werner, 1995). With the recent election of regional councillors with jurisdiction over areas traditionally managed by the ward headmen, the situation has become particularly complex. A commission into the affairs of traditional leadership structures was established in 1991, but the findings have not been made public (BICON/LCE, 1992). This distribution of power at a community level is also an important consideration in determining how much public knowledge, attention and reaction there will be to a proposed development project (Dye, 1986 in Rickson *et al*, 1990a).

4.2.2 The natural resource base

Throughout southern Africa, low crop yields due to infertile and drought susceptible soils, and low carrying capacity for livestock, are serious limitation to subsistence farmers and pastoralists (Marsh and Seely, 1992). Consequently there is always some degree of reliance on the natural flora and fauna, particularly between harvests and during droughts. Tenural rights to grazing on commonage and access to resources such as fish, water, wood and game animals are a feature of communal lands in southern Africa. The maintenance of biodiversity is a valuable aspect of this form of self preservation. Although the traditional system is changing, for years common access to a fairly diverse natural resource base has enabled the Owambo people to survive extreme droughts and numerous other natural limits to agricultural.

Kalahari sands and sandstone are the characteristic soil type in Owamboland forming a gentle undulating plain with an altitude ranging between 1 100m and 1 200m. The soil structure is generally poor and agricultural activities are consequently concentrated on the floodplains in the *oshana* region of the Cuvelai drainage system. Most of the region is dominated by well leached solonetz soil which have a tendency to form a hard layer between 20 and 100cm under the surface (Marsh and Seely, 1992). This compacted lower horizon is characterised by low permeability and high sodium activity. Consequently the soils tend to be saline and fairly infertile. Salinity levels decrease westwards but this advantage is counteracted by increasing aridity.

The area around the Olushandja Dam is dominated by brown solonetz soils, and grey solonetz soils in areas of depressed relief. Mopane (*omusati*) woodland and mopane savanna are the dominant vegetation type supported by these soils and these woodlands are extensively exploited for fuel and construction materials. Despite the unsuitability of this soil type for dryland cropping, population pressure necessitates that these areas are cultivated (A.O.C. Technical Services, 1967b).

A band of locally derived aeolian soils occur immediately west of the Olushandja Dam. These soils are slightly salty with a relatively high clay content. The reasonable agricultural potential of these soils have formed part of the justification for the establishment of the Etunda irrigation scheme in this physiographic zone. Non-solonetz soils with calcrete and aeolian sands occur on the western edge of the Cuvelai drainage basin within 10km of the Olushandja Dam. These soils have a relatively high clay content and are considerably more fertile supporting a mixed woodland type veld (Irving *et al*, 1993). The agricultural potential of these soils has not been extensively exploited due to a very low rainfall and lack of surface water supply.

The Owambo's interaction with the flora and fauna of their natural environment constitute a long tradition of securing means for survival. In the past a diverse range of plants provided a variety of resources in the form of wild plants and fruits, edible greens and caterpillars, wood for fuel, construction of homesteads and carving of utensils, reeds for basket making as well as traditional medicines. Tree tenure also formed

an important component of the land-use system. Before colonial expansion certain trees, especially fruit trees s, were controlled by the kings who reserved certain rights to these trees. Trees outside individual homesteads are regarded as communal property but the responsibility of the headman (Kreike, 1995). Edible fruit and shade producing trees, such as the Marula, Berchemia, Palm and Diospyros are traditionally conserved in most communal areas (Marsh and Seely, 1992). The leaves and bark of many of these trees are also used in basket making and mat weaving.

Thus, despite the Owambo people's dependence on crop cultivation and cattle rearing, natural vegetation still forms an important part of the land use system and makes a valuable contribution to the subsistence economy. However a number of simultaneous degradation processes are taking place throughout the *oshana* area. These affect not only rangeland and pasture, but also woodlands and arable land (Quan *et al*, 1994). In recent years, due to extensive overgrazing and deforestation, useful plant and tree species are becoming scarce. As a result there is a growing cost of utilisation, in terms of increased labour time, increased transport costs, and expenditure on commercially available substitutes for natural tree products, notably for building materials and fuel (Quan *et al*, 1994).

The problem is compounded by the inadequacy of the once efficient traditional mechanisms for allocating land and controlling access to commonage, water and forest resources. Continuing impoverishment of the natural resource base in communal areas reduces the potential contribution of the fruit and forestry component of the agro-silvipastoral system to the local subsistence economy. As population pressure continues to increase, future cost of substitute resources will be significant and conservation programs will have to be introduced if the exploitation of woodlands and natural vegetation is going to continue on a sustainable basis (Marsh and Seely, 1992).

4.2.3 Crop Production

Agriculture is the basis of the Owambo economy and will remain so for the foreseeable future. The primary crops and staple diet of the people comprises *mahangu* (pearl millet) and sorghum. Without exception all the households interviewed during the course of the study planted *mahangu.* On average farmers produce 250 to 400 kg/ha but this can fall to 70 to 100kg/ha in years of low rainfall (BICON/LCE, 1992). There is no formal market for *mahangu* and surpluses are either stored, bartered or shared with family and relatives.

Sorghum is mainly used for beer making and when combined with *mahangu* flour it provides a milder drink for daily consumption. These drinks form an important part of the local diet (Williams, 1991). There are several varieties of *mahangu* including traditional *Okashana, Engipiti* and *Kwanyama* or traditional *mahangu* (Kreike, 1995). The latter is fairly slow growing, requiring the most rain and is distinguished by a very long stalk. The other varieties are cultivars which are much faster growing with shorter stalks and longer heads. Two varieties of *Okashana* have been specially developed as high producing dwarf cultivars which ripen in three months (Krieke, 1995). Despite the advantages of the new

cultivars, most households still plant the traditional *mahangu* in conjunction with the new varieties for several reasons:

- the traditional variety is highly adapted to the local climate, the seed is always available and it does not have to be bought with cash.
- the long stalks of traditional *mahangu* are used for construction.
- *Okashana* cannot be intercropped with other varieties because it grows much faster and outshades other varieties.
- *Okashana* varieties do not store well and the grain is an attractive host to pests.

Furthermore, Hindmarsh (1990) warns that the price attached to the new hybrid varieties of *mahangu* may be beyond the means of the average small farmer. The benefits offered by hybrids are consequently restricted to an elite group of wealthier farmers. The gap between rich and poor is consequently widened and this may lead to indebtedness, tenure displacement, landlessness and socio-cultural breakdown.

The *mahangu* seeds are usually planted after the first rains in November/December when the fields have been prepared using ploughs drawn by oxen or donkeys and hand hoes. Seed varieties are obtainable from the Ministry of Agriculture and the Mahanene Agricultural Research station where new *mahangu* varieties are researched and developed. With later rainfall more seeds are planted, minimizing the risk of total crop failure if there is a mid-rainy season drought (Marsh and Seely, 1992). Crops are harvested in April and May. In the interim fields have to be kept free of weeds. This is a very labour intensive activity as weeding is done by hand using a hoe and often up to three weedings are required to ensure an optimum yield.

Weeding and harvesting of *mahangu* is a social phenomenon in the rainy season, as neighbouring homesteads assist each other in agricultural work. This means of social interaction is particularly significant in sparsely populated areas where distance between homesteads ranges from 500m to 2km. Such cooperation was observed particularly on the eastern side of the Olushandja Dam where the host farmer served a meal and beer to those who came to assist. Harvested *mahangu* is transferred into large storage baskets, sealed and lined with clay. This composite of materials effectively accommodates humidity generated by the contents (Krieke, 1995).Ashes are added as an insect repellent and the basket is placed under a roof. This storage technique is highly effective and grain may be kept for up to 5 years.

Most households also produce rain fed vegetable crops such as pumpkin (*etunga*), cowpeas (*omakunde*), beans (*efukwa*) and watermelons (*ekanuwa*). These vegetables are either grown in the *egumbo* or intercropped with the *mahangu*. A major constraint to growing a wider variety of vegetables throughout the year is the lack of water and a means to convey water to the homestead. Most households do not regard vegetable growing as an activity worth excessive time and effort. Vegetables are often bought from the market gardens on the west bank of the dam, hawkers, *cuca* shops or the Etunda irrigation project.

The extent of crop losses both before and after the harvest as a result of pests and insects varies from year to year. Crops are particularly vulnerable to attacks under drought conditions. Pre-harvest losses are primarily a result of armoured crickets, birds and worms, whereas rodents, insects, bacteria and fungi are the causes of post-harvest losses in the granaries. Sorghum is subject to attack by aphids which are known elsewhere in southern Africa to reduce yields by up to 60% (Marsh and Seely, 1992). In 1915 the harvest throughout Owamboland was lost on account of an invasion of army worms which contributed into transforming a serious drought into a famine which killed or displaced thousands of people (Kreike, 1995). The devastating impact of army worms was witnessed on the east side of Olushandja Dam where groups of homesteads were suffering severe crop losses. It seemed that the worms had to be physically collected by hand and disposed of. The problem is exacerbated when crops are planted late in the season in response to delayed rainfall, the plants are consequently still too young and small to withstand the infestation. The impact of pests can be mitigated by using a variety of cultivars, intercropping and maintaining natural vegetation in the form of trees and bushes in and along the fields (Kreike, 1995).

Many of these techniques, including intercropping, minimal tillage and informal agroforestry used to cultivate traditional crops, are sound and sustainable environmental practices. The local cultivation system is, in many ways, highly efficient, providing the staple food for nearly half of Namibia's population on a fraction of its total landmass. Despite severe problems associated with overpopulation and degradation of the natural resource base, it is nevertheless unlikely that "commercial" farming based on monocropping, mechanised ploughing in conjunction with clearing of trees from fields would achieve the same degree of resilience and sustainability as the traditional land-use system.

The entire process of modernisation of agriculture in developing countries is very complex. Chamala (1990) identifies several shortcomings of past attempts to improve agricultural productivity. For example, research undertakings focused on cash crops requiring high inputs of fertiliser, water and chemical pest control, and indigenous knowledge of eco-farming and biological control mechanisms dismissed. According to Lechner (1995) of the Mahanene Research Centre this was certainly the case with regard to agricultural development in Owamboland. Only recently has the research emphasis shifted to dryland crops, tree based ecofarming and fish production. Agricultural programs currently underway at the Mahanene Research Centre are concerned with the integration of modern technology with traditional subsistence farming practices. Sociological research into community structures, land tenure systems and political factors forms a basis for successful agricultural modifications in a developing context.

An obvious benefit of the Olushandja Dam for those who live in the vicinity would be potential for irrigation using water from the dam as this supply is available throughout the year. The market gardens, Elao and Epalela situated on the west bank of the Olushandja Dam pump water from the dam using a solar powered generator. The vegetables are watered using a simple drip irrigation system comprising two large water tanks and several pipes and hoses. Epalela receives financial aid from the Northern Namibian Rural Development Program (NNRDP) and Elao, a self-help project for disabled people, is supported by the Ministry of Lands and Resettlement and the European Economic Commission.

Irrigation proved a difficult topic to discuss during the household interviews as the interviewers, the respondents, and the translators differed in their understanding of the concept of irrigation. Those people in Zone A had an understanding based on the system used at the market gardens which they associated with high financial input. All the respondents in Zone C seemed familiar with the concept of irrigation, some perhaps with first hand knowledge of spray irrigation at Etunda. It was evident that some households had attempted the construction of canals from the dam to their *epyas*, but these require consistent maintenance. For most households the time, effort and financial input required to plant and water vegetables is not considered worthwhile.

In addition to lack of finance there are a number of other constraints regarding irrigation potential of the areas around the Olushandja Dam and the practice should be encouraged or assisted with caution. Spray irrigation is costly and fairly ineffective owing to high evaporation losses. Flood irrigation is inadvisable owing to the susceptibility of the soils to salinization. There is some potential for hand watering or drip irrigation for intensive household vegetable gardening using water from the dam or canals. It could be encouraged through the provision of suitable containers or simple pumping mechanisms. This will only benefit those in close proximity to the reliable water supply. It is likely that some members of the community may be opposed to using potable water from the pipeline for irrigation purposes.

The traditional system of crop cultivation is based on extensive and valuable indigenous knowledge the benefits of which are not likely to be easily matched by technological innovations.
There is undoubtably room for improvement and scope for change in the production methods, particularly in the vicinity of Olushandja Dam where there is a reliable supply of water. However, practises such as irrigation and biotechnology should not be developed at the expense of the in-built flexibility and resilience of the existing system. Improvements should be based on local technology and address the specific needs and priorities of the communities.

4.2.4 Pastoralism

Livestock rearing is an integral component of Owambo people's lifestyles. Cattle and goats are a source of milk, meat and manure to fertilise fields, but their real value is based on their traditional but largely profane roles as status symbols and a source of wealth. Cattle are economically more important than land because they are inheritable property (Williams, 1991). A herd of cattle basically functions as a savings account and insurance fund (Krieke, 1995). Cattle may be exchanged for grain in times of food shortages and cattle owners have a long tradition of selling some cattle to traders in a good breeding season (Marsh and Seely, 1992).

Cattle are divided into 6 main categories: breeding, sacrifice, inheritance, bride wealth for refund or ransom, and for barter. A certain number of cattle are reserved for breeding to increase the wealth of the owner. In the past a number of cattle were kept for the purpose of being sacrificed during ritual ceremonies (Williams, 1991). These have become less common and cattle are generally slaughtered for

special feasts or by wealthy farmers to thank neighbours for assisting in the fields. Cattle are also slaughtered and sold to pay school fees and clinics. Cattle bred for bride wealth are often of a certain breed. Special stock may also be bred and reserved for payment for a death caused by a member of a household. Historically cattle ransom were paid by one kingdom to another to retain their war captives (Williams, 1991). Finally, cattle may be exchanged for land or other desired goods.

Not every cattle owner has all six categories of cattle, especially as emphasis has shifted from their religious function, to cattle as a mobile economic resource. Cattle numbers have also decreased despite the long term increase in human population. In fact the balance between pastoralism and crop production was significantly altered in 1890's by a massive outbreak of rinderpest which struck the whole of southern Africa and destroyed over three quarters of the Owambo people's cattle. (Williams, 1991). More recently, droughts in the 1970's and 1980's caused a progressive decline in the size of the regional herd as well as the mean herd size per household. Based on livestock census data, the cattle population is estimated to have declined from 379 500 in 1960 (a cattle to person ratio of 1.7:1) to 350 000 in 1990 (a ratio of 0.88:1) (Marsh and Seely, 1992).

According to Dr Odihao of the Directorate of Veterinary Services, there are approximately 93 000 heads of cattle in the Tsandi and Okahao districts of Omusati. He emphasised that it is virtually impossible to provide anything other than a rough estimate of cattle numbers as "an Owambo man will never tell you the actual number of cattle he owns" (Odihao, 1995). According to Williams, 1991 cattle are often not kept in one place to reduce losses through cattle raids in the past and endemic diseases, but also to keep secret a person's wealth which is known only to himself and members of his family. 50% of households interviewed responded to questions regarding the number of livestock they owned. The average herd size per household was 24, but individual herd sizes varied from 2 to 135. These results were consistent with studies undertaken in other parts of Owamboland: an SSD survey in Ukwaluudhi found the average herd size to be 15 (Irving *et al*, 1993) and the ORMP survey found an average of 17 cattle per household (BICON/LCE, 1992). The number of households owning no cattle at all in the present study was assumed to be 50%. Similarly, a UNICEF survey undertaken in 1990 found that 52% of the households in the rural areas of northern Owamboland owned no cattle at all.

Ownership patterns of cattle are in a state of flux. Despite difficulties associated with determining cattle numbers it would definitely seem as though cattle are progressively becoming concentrated in the hands of fewer and fewer owners (Marsh and Seely, 1992). It is the emerging sect of cattle "barons" that are responsible for the fencing of communal areas. The trend is mitigated, to an extent, by a system of cattle lending which seems to ensure common access to livestock products such as milk and manure (Marsh and Seely, 1992).

In the past cattle remained at the homestead while the availability of grass and water were sufficient to support the animals, until the onset of the dry season. After harvesting cattle are allowed to graze on the left over millet and sorghum stalks in the field, adding manure to the soil and preventing overgrazing in

communal areas near populated settlements. In parts of Owamboland, this period used to be regarded as a grazing feast associated with festivities and ceremonies. In the dry season cattle were taken by cattle herders on *ahambo* to cattle posts in the west where there was grass and water available from hand dug wells and boreholes. Cattle are bought back at the onset of the rainy season. Initially they are kept in the higher areas of the floodplain not used for crop cultivation. When the rain- and flood-waters recede, the cattle move to the grazing in the *oshana* beds.

This system of transhumance in response to seasonal vegetation changes is the primary differentiation of Owambo people from nomadic people such as the Himba in adjacent Kaokaland.

In recent years a change has been observed in the traditional movement and management system. According to Marsh and Seely (1992), with the construction of pipelines and canals and consequent presence of water year round means that cattle can be kept in the inhabited zone longer. Others have observed that households are increasingly unable to bring their cattle back to the floodplain even during the rainy season owing to insufficient grazing (Krieke, 1995). It is apparent that the benefits of permanent water supplies have to be balanced by the availability of grazing. With increasing population pressure taking its toll on the natural resources in the central floodplain area, the latter is becoming the key determinant in the ownership and management of cattle throughout Owamboland.

A trend in this regard is noticeable in the vicinity of Olushandja Dam. A number of respondents particularly adjacent to the dam told how cattle have to be kept at cattle posts throughout the wet season despite the availability of water, because there was no longer sufficient grazing in the inhabited zone. It became evident that the Oshana Etaka was an important grazing area after the seasonal floodwaters had receded, prior to the construction of the Dam. Contrary to expectations the presence of the dam has not attracted livestock to the area as the *oshana* bed grazing is no longer available. Only relatively small groups of cattle used for ploughing are kept at the dam throughout the year. The band of vegetation adjacent to the water's edge, mainly water tolerant grasses and some herbaceous groundcover, is heavily overgrazed by those animals that do return in the wet season.

- The presence of canals act as a further limitation to the transhumance system, particularly the concrete lined Olushandja-Ogongo canal which can only be crossed by bridges which are few and far between along the length of the canal. The cattle north of the canal no longer have easy access grazing reserves in the south west during the dry season. The access problem is compounded by the fencing of former grazing and fodder reserves by wealthy individuals.

The most common breed of cattle is Sanga, small hardy animals which are indigenous to northern Namibia and southern Angola. Although it has been argued that Sanga cattle are not very productive (Tapscott, 1990), they are nevertheless well adapted to the harsh local conditions. This is important as livestock are subject to numerous diseases including anthrax, lung sickness, botulism and rabies. Water borne diseases are particularly prevalent in the vicinity of the Olushandja Dam. These include

schistosomiasis and salmonella which affects man and cattle as well as paramphistomum infestation (Odihao, 1995). These diseases are promoted by stagnant water which gives the intermediate host a chance to establish itself.

A number of the respondents in the study complained of cattle diseases, although these were generally described in terms of symptoms which made it difficult to identify exactly which diseases are most prevalent. It would appear that botulism and lung disease are common. Anthrax is particularly problematic Although losses of animals are relatively minor meat of the cattle becomes dangerous for human consumption. Animals are particularly prone to disease when weakened by drought conditions. It was evident during the study that many households had lost all their cattle due to drought alone.

The spread of diseases southwards is prevented by the so-called "Red Line" veterinary cordon beyond which live or slaughtered cattle from Owamboland and southern Angola are not allowed to be transported Livestock owners consequently do not have access to external markets and the problem of overstocking and overgrazing in Owamboland is intensified.

The small informal settlement of Epalela has become and important trading centre and market for cattle often originating from Angola (Shipena, 1995). Dr Odihao of veterinary services expressed concern about diseases, particularly tick borne, which might be brought across from Angola. Cattle sickness and deaths may also be associated with overgrazing. After the first rains the sudden appearance of plant and grass cause encourage often leads to animals dying of consumption and poisoning as many of the fast growing plants are inedible.

The concept of carrying capacity features prominently in discussion and debates about overgrazing and desertification problems in Owamboland (Krieke, 1995). Dr Seely, co-ordinator of the Namibian Desertification Program, regards the concept of carrying capacity as problematic. Grazing patterns are seasonal and highly variable making it almost impossible to calculate the carrying capacity per hectare. The Department of Agriculture gave an estimate for Omusati in 1974 of 1 livestock unit per 12 ha. Research at the Ogongo Agricultural College has shown that the *oshana* beds can sustain 1 livestock unit per 2ha for a period of 6 months. The area covered by the Olushandja Dam consequently represents a significant loss of grazing in Omusati.

Smallstock, mainly goats, and some sheep, pigs and poultry are also important sources of protein and manure. The smallstock browse on communal grazing land near the homestead and often put into enclosures at night. 75% of the household interviewed during the study owned goats. The average goat herd size was found to be 20 in the vicinity of the dam, consistent with a mean household ownership of 22 in the Uukwaluudhi area (Irving *et al*, 1993).

Donkeys are also kept and shared with neighbours as draught animals and for the transport of water and wood supplies. These animals have a substantial impact on vegetation and soils because of their foraging

habits and because they concentrate around water supply points in the absence of herders (Krieke, 1995). At least 29% of households interviewed around the dam owned one or more donkeys. The total number of goats in Owamboland was estimated at 360 000 in 1990, compared to 350 000 cattle. Unlike cattle their has not been a significant decrease over the years in the number of goats per household (BICON/LCE, 1992).

4.2.5 Fishing activities

Historically, fishing in *oshana* area was an opportunistic activity in response to flood events. The Oshana Etaka was an important seasonal watercourse carrying fish from the Cunene southwards to Lake Oponono and the Etosha Pan. With the construction of the Olushandja Dam, fishing activities are no longer confined to the wet season and fishing with baskets, lines, drag nets and throw nets is an important activity associated with the dam throughout the year. The most common species caught are bream (*Oreochromis spp.* or *Tilapia spp.*) and catfish/barbel (*Barbus spp.* or *Clarias spp.*) (Hay *et al*, 1994; Tvedten *et al*, 1994).

Fishing is an important source of income as well as a significant component of people's diets as one of the few sources of protein. Approximately 30% of households interviewed were involved in fishing activities. The majority catch fish for household consumption only, although in some cases surplus are sold. A distinct group of fishermen reside at Epalela and are reliant on fishing as a source of income. Here there is informal local trade in fresh and dried fish with prices ranging considerably from N$2 to N$60 depending on the size and species of the fish.

Fishing with lines or drag nets, appeared to be a male dominated activity although women were observed using throw nets and baskets in the shallow water along the banks of the dam. Some fishermen make use of dugout canoes to access the deeper water. Other are wary of using dugouts as these are easily overturned. None of the people interviewed were able to swim and expressed fears of drowning.

The size of catches are to some extent seasonally dependent. The fishermen interviewed agreed that catches improved in the wet season when the level of the dam increases and the water quality improves or becomes less turbid. The distribution of fish in the dam depends on water temperature. In very hot weather fish congregate in the cooler, deeper water towards the middle of the dam.

The permanent presence of fish holds significant social and economic benefits for surrounding communities. There are, however, a number of limiting factors to the exploitation of the full potential of this valuable resource. The most significant of these is associated with the cost of hooks, nets and lines. Fishermen at Epalela indicated that nets could cost up to N$600. This can be attributed to a monopoly on the sale of so-called Castenela nets by an Angolan businessman. The price of hooks was quoted at N$1.60 per hook, making the technique, known as *omulavalava,* involving a series of hooks (up to one hundred) attached to a piece of line, an expensive option. Generally the capital required to invest in

fishing equipment, most likely owing to a monopoly on trade, is considered beyond the financial means of the average household. Prior to dam construction, fish were speared with sharpened sticks or caught by hand in the shallow water of the *oshanas*.

A secondary factor is related to people's fear of deep water and suspicion of boating activities. According to Williams (1991) a legendary tale among Owambo people tells of invaders of kingdoms paddling down the ephemeral rivers by boat. Suspicion arose over these strangers as floating crafts were something very unusual at that time. This attitude is still prevalent amongst people in the study area, particularly since a number of individuals have drowned either while fishing or attempting to cross the dam on foot.

To date there is no official policy document regarding fishing on inland water bodies in Namibia, although a White Paper on Freshwater Fish is being prepared by the Ministry of Fisheries and Marine Resources (Hay, 1995). Traditionally fish are regarded as a communal resource for exploitation by all Namibians. Some antagonism directed at Angolans coming across the border to fish in the Olushandja Dam was, however., expressed during interviews with some of the fishermen in the study area. The Department of Nature Conservation has made some attempt to control fishing activities on the dam through the headman to prevent overexploitation. This has been in conjunction with programs to prohibit the poaching of wildlife and large water birds such as pelicans and flamingoes. People had apparently been warned only to fish with nets of a specific mesh size at certain times of the year. According to the respondents the situation is being monitored by Nature Conservation officials. As white people in government vehicles, it was consequently difficult to approach fishermen engaged in activities on the banks of the dam without arousing fear and suspicion. Nevertheless, reassurance on behalf of the study team led to an adequate amount of forthcoming information.

None of the people involved in fishing activities were opposed to the idea of some kind of control mechanism to prevent the utilisation of the fish resource on an unsustainable basis. It was generally expected that fishing permits would be released and it was suggested by the informants that a group of residents around the dam be democratically elected to enforce appropriate regulations.

4.3 Social Structure and Gender Roles

The social and political organisation of the Owambo communities is based on matrilineal principles - the line of descent runs through the maternal line. This also applies to royal succession as the heir belongs to the royal family on the mother's side. Social organisation is based on the same principle. This means a child's identity lies with his or her mother's family and the paternal clan has no social obligation to the child other than the role it plays in upbringing. Thus a woman does not become a member of her husband's family by virtue of marriage and nor do their children (Williams, 1991).

By contrast the household structure is patriarchal and the man is generally regarded as the head of the household and is responsible for maintaining residential unity (Naeera and Solomon, 1994). A woman

can become the head of the family if her husband dies or if she establishes her own homestead after divorce. A number of female headed households (largely widows) were encountered during the cause of the study. In the past these homesteads would acquire the name *okagumbo* instead of *egumbo*, a diminutive meaning small household.

According to Williams (1991), religion forms the fundamental basis of a social structure where men have a dominant position in the family and society. This is because traditions are regarded as part of religion and these deal with ritual practices, wars, cattle raids and salt collecting trips which were all male dominated activities. Polygamy was not uncommon in Owamboland and closely linked to the agricultural production system as wives were responsible for their own individual plots and those of their husband. With the arrival of missionaries and the introduction of church marriages, polygamy was discouraged and no longer forms a part of the Owambo social structure. What is still common is the system of extended families. On marrying, a son or daughter often sets up a household adjacent to that of the parents. This provides social and economic support and serves as a basis for child rearing (BICON/LCE, 1992). Children are often raised by family members other than their natural parents. It is also usual for a parent, usually female, to live with her children on the death of her husband.

Female headed households are becoming increasingly common as a consequence of the migrant system. Many men of working age are absent from the rural areas and employed on the diamond mines in the south or in Windhoek. 31% of the households interviewed in the study were female-headed households. The number of people occupying a household varies between 3 and 17 with the average number being 8. This result is again consistent with that of Irving *et al* (1993) and the ORMP survey (1992) who found an average of 7 and 8 people per household respectively. According to the National Planning Commission (1994), the average size household for the Omusati region is 6 with 57% female headed.

Families of migrant labourers supposedly receive remittances from absentee husbands and fathers. It is however not unusual for a female headed family to receive money only once or twice a year.
It is not common practice for a family to move from Owamboland to the place of a husband's employment as the ownership of cattle and use of land remains an important tradition and symbol of wealth even for those whose livelihood is based elsewhere. Formal employment in Owambo is restricted to public service and small commercial sectors in towns such as Oshikati or Tsandi.

The land-use system in former Owamboland is responsible for some degree of labour division and specialisation. Traditionally most of the agricultural work is left to the women and girls in the household while males took over the custodianship of pastoral activities. This division is not as marked as it used to be although the occupational group of cattle herders is exclusively male dominated.

Age and gender biases are particularly noticeable in the Omusati region where 48% of household members are under the age of 15 and the male to female ratio is 79:100 (National Planning Commission,

1994). This would suggest that the growth rate in Omusati is likely to be higher than the average population growth rate for Owambo which is approximately 3.03% (Marsh and Seely, 1992).

4.4 Community Health

It has long been recognised that development projects, notably water impoundments, may have negative health consequences (Burdge, 1990). Some of the worst human diseases are of a parasitic nature, transmitted to man by vectors such as mosquitoes and snails that breed in shallow, standing water. Impoundments expand breeding areas, increasing the density of vectors in the vicinity, thereby submitting local populations to higher risks of infestation (ICOLD, 1992). WHO officials have noted that the cost of submitting proposals with possible implications for health to SIA is far less than the cost of correcting unforeseen negative impacts after implementation (Burdge, 1990). In southern Africa one of the main social impacts of dams is an increase in the incidence of bilharzia and malaria (Bisset, 1984). In the study area such health problems are inevitably related to, and exacerbated by poverty and underdevelopment. According to Sagar (1994) poor people are always less healthy and will have poorer access to medical care. This leads to greater morbidity and mortality in the socially and economically weaker sectors of society.

The exact nature and extent of disease related illnesses amongst local populations is difficult to determine. As Marsh and Seely (1992) point put the scattered nature of the rural Owambo communities means that many diseases are not reported. The Ministry of Health and Social Welfare report malaria to be the most serious health problem in northern Owambo region. The presence of standing water in the *oshanas* and pans act as ideal breeding grounds for the malaria-carrying *Anopheles* mosquito, as do the relatively shallow stagnant waters of the Olushandja Dam. Occurrence of water related illnesses exhibit seasonal cycles, for example, malaria and dysentery is more prevalent in the wet season (Marsh and Seely, 1992). In the study area, however, people indicated that some diseases, such as bilharzia, were more common in the dry season when people and cattle become increasingly dependent on the dam water.

Research by the National Planning Commission (1994) indicates that health, along with water supply and education, is regarded by local communities as a development priority in the Omusati region. Health concerns were expressed by a number of households interviewed in the study and clinics or hospitals were identified as a as comprising a large proportion of household expenditure. Of the people interviewed in Zone A, one third indicated that at least one member of the household had contracted bilharzia. Other complaints that could be contributed to the consumption and utilisation of unpurified water include stomach cramps and diarrhoea. By contrast, those people who rely on the purified pipeline water seldom contract water-related illnesses.

Few of the households reliant on the dam or the canals boiled drinking water and most showed little inclination to do so, due to a lack of time and an insufficient number of containers to hold purified and unpurified water. Practical constraints such as wet wood in the rainy season contribute to people's

reluctance to establish a regular boiling routine. This is despite a raised awareness of the health risk associated with the consumption of raw water, as a result of education programs and warnings issued by clinic and hospital staff. Health problems are exacerbated when animals that have died from water related illness such as liver fluke are subsequently consumed.

Local health services in the study area comprise four day clinics at Mahanene, Ooshala, Eunda and Onesi. The latter is being converted into a "health centre" which will be equipped with 20 beds for overnight patients. The nearest hospitals are at the towns of Ombalantu and Tsandi 30 to 40km to the east and south of the dam respectively. Serious cases are referred to Oshakati. According to health records at the clinics incidences of malaria have decreased over the last three years whereas bilharzia is becoming more prevalent. However, this trend could be a reflection of an increase in the number of people seeking treatment. The clinic staff are also responsible for health extension work and education programs amongst the rural populations.

The correlation between the dam and water borne disease and illness identified during household interviews was reinforced by the key informant interviews with clinic and hospital staff. According to nurses at the Onesi clinic, incidence of disease increased markedly as a result of the presence of the Olushandja Dam. Physical evidence supporting this observation was presented in the specialist report investigating the distribution of freshwater snails and snail-borne diseases associated with the Calueque-Olushandja water supply network (Curtis, 1995).

Curtis recorded the occurrence of *Bulinus globosus*, a snail species acting as the intermediate host for urinary bilharzia associated vegetation bordering the north wall of the dam and the inlet of the Calueque-Olushandja canal. People were observed washing, swimming and fishing in this area. The presence of *Lymnaea natalensis*, intermediate host for liver fluke, was also reported to occur in the vegetation and grazing grass in the shallow waters of the dam.

Although people are clearly aware of the financial and social burden of ill health, the situation appears to be fairly passively tolerated. Consistent cases of diarrhoea, especially among children, and regular visits to the clinic for the treatment of more serious illness are regarded as an inevitable component of people's lifestyles. According to Sagar (1994), in a developing context, health describes an individual's relation to the concept of normality which asks for much less than an ideal state of positive health. Perceptions of ill-health differs among social groups at different income levels - people's own concept of what it means to be healthy varies widely depending on the situation in which they may find themselves (Sagar, 1994). Thus, provided an individual's state of health is not significantly different to that of their neighbours, the health situation corresponds to normality. It is only through external influences that expectations are raised and demands made for a changes to the public health paradigm.

4.5 Settlement Patterns

Original settlement in Owamboland was determined by the suitability of an area for traditional agriculture. Such locations were generally on the higher ground adjacent to the *oshana* beds, which acted as a source of water in the rainy season. In the recent past, with the population growth rate exceeding 3% a year, land availability, infrastructure and space have become primary determinants of settlement distribution and patterns. Secondary factors responsible for the disruption of past settlement trends include the artificial division created by the political border between Namibia and Angola, as well as the border war which caused large numbers of people to flee or relocate from isolated rural areas to more densely populated and safer parts of Owamboland. The situation is now reversed with the influx of repatriates and refugees accompanied by livestock, back into northern Namibia.

According to Williams (1991) there has been a shift in emphasis from natural factors based on the quality and suitability of the land to anthropocentric determinants, as populations concentrate around centres drawn together by both social and political organisation. The last 20 years have been characterised by urbanisation and rapid growth of a cash economy (Marsh and Seely, 1992). The resulting urban economies of towns such as Oshikati and Ondangwa are mostly self-contained with limited connections to the surrounding rural subsistence economy. In the study area, dense settlement around Eunda, Onesi and Epalela to the west of the Olushandja Dam are indicative of this phenomenon. These concentrated settlements are nevertheless peri- rather than true urban areas. There is still an indistinct separation and interrelationship with surrounding scattered rural households whose occupants attend church, clinics and rely on infrastructure and services offered by Eunda and Onesi.

A component of the household interview was aimed at determining how the provision of a permanent water supply has influenced the social environment. Preparatory research indicated, and it was expected that such an influence would manifest itself the nature of settlement distribution and changes. Field investigation and analysis of aerial photographs revealed fairly consistent population numbers in Zones A, B and C and no significant increase or decrease with distance from the dam. Areas of concentration characterised Zone B in the form of Eunda and Onesi, but the presence of these settlements did not significantly distinguish this zone in terms of average number of people.

In Zone A, 23% of the respondents have been living in the same place all their lives compared to 76% in Zone B and 38% in Zone C. This would suggest that an area between 2 to 5 km away from the original Oshana Etaka was attractive for settlement, particularly on the west side of the dam. Extensive bands of locally derived aeolian soils characterised by better drainage and working properties occur in this zone. This material would have been preferentially chosen for agriculture within reasonable distance from a water supply in the form of the Oshana Etaka. Eunda and Onesi would thus represent original nodes of settlement and development.

Responses to the household questionnaire indicated that settlement closer to and further away form the Olushandja Dam, in Zones A and C was largely controlled by the availability of land. Movement and relocation appears to be confined within the local area with no detectable influx of people from other constituencies and parts of Owamboland. Secondary attractions to areas further to the west of the dam include the availability of grazing and soils of reasonable agriculture potential. Those areas within 1 to 2km of the do not comprise prime sites for settlement development and relocation as may have been expected. Several reasons for this became apparent during the course of the study:

- Although the dam represents a permanent supply of water, this is at the expense of the availability of grazing that characterised the original Oshana Etaka after the floodwaters had receded. The banks of the dam are not as suitable for livestock as the areas further west where grazing and borehole water is available.
- The dam is associated with sickness in the form of malaria and bilharzia.
- It is well known amongst residents that the dam water is polluted by washing, cattle and fishing activities and is not suitable for consumption. A number of respondents indicated a need for a supply of clean, potable water and would prefer to be living closer to the pipeline situated in Zone B.
- Distances between homesteads are greater around the dam. A number of people expressed their desire to be close to family and have neighbours nearby to assist in agricultural activities. There was a reluctance to be located in isolated places and people in Zone A were not averse to the idea of increased settlement despite the limited availability of natural resources. A probable effect of the war is the fact that denser settlement is also associated with safety.

Only two respondents identified the dam as a motivating factor in their decision to move from their original place of residence. Newcomers were often identified as young married couples or old widows allocated land by the headman where such land was available.

Nevertheless, most respondents said they were glad the dam had been built as it provides a valuable permanent source of water for people and livestock, which, unlike wells and boreholes, does not require construction and maintenance effort. Furthermore, the dam also allows fishing activities to continue throughout the year.

4.6 Water Resources

Water is the most important limiting factor to development in north-central Namibia. Historically, this is reflected in the importance attached to the art of rain-making, an important ritual which used to be vested in the Ndonga royal clan (Williams, 1991). Considering the nature of the surface water supply in the form of the *efundja,* it can be understood how this sudden abundance can be attributed religious significance. The availability of water is also a primary factor in determining settlement patterns and the seasonal land-use system.

Water sources can be divided into two categories: intrinsic sources which includes surface run-off in *oshanas* and pans as well as groundwater supplies, and extrinsic sources, including the government supply of piped and canalised water (Irving, *et al*, 1993). The Olushandja Dam is an extrinsic water source built in the place of an intrinsic supply in the form of the Oshana Etaka, the biggest and most distinct *oshana* in former Owamboland.

4.6.1 Intrinsic water sources

Pans

Pans are isolated depressions characterised by clay deposition which acts as a barrier to water percolation thus promoting the retention of standing water (Irving *et al*, 1993). These pans do not form part of the *oshana* system and act as a valuable source of relatively clean water during and for a few weeks after the wet season. The discontinuous nature and clay lining of pans is what distinguishes them from small *oshanas*.

A number of households in the study, particularly in Zone B collect water from pans in the wet season and the beginning of the dry season before these dry up. Pans also act as watering holes for cattle. The study team noticed that pans close to a group of households were often fenced off for the exclusive utilisation by a certain number of families. This is illustrative of a change in attitude towards communal resources in response to increasing population pressure as discussed by Marsh and Seely (1992).

Oshanas

During the wet season drinking water for human and animal consumption is taken directly from the *oshanas* often in preference to other water sources. These ephemeral water courses may be derived from localised rainfall as well as rainfall on the Angolan highlands between the upper courses of the Cunene and Kavango Rivers. Depending on the amount of rain, water in the *oshanas* is still standing or flows slowly southward although the velocity of water rarely exceeds 0.5m/sec and there are few well defined flood channels. Flood waters are reported to reach Lake Oponono south-east of Tsandi on average twice every three years (Department of Water Affairs, 1992). Major floods (*efundjas*) are estimated to have a one in fifty year return period and are critical for the recharge of groundwater reserves and rejuvenation of vegetation. During these periods floodwaters drain all the way to the Etosha Pan.

Standing water may remain in low lying parts of *oshanas* for several weeks after flow has occurred but generally the *oshanas* tend to dry up fairly rapidly at the onset of the dry season. Grazing grass in the moist *oshana* beds is important fodder for cattle returning from *ahambo*. The average depth of the *oshanas* was estimated in the field to be approximately 500mm after a good rainy season. All the households interviewed in the study depended heavily on the *oshanas* as a major source of water in the

wet season. The *oshanas* become progressively more diffuse west of the Olushandja Dam and disappear altogether at a distance between 5 and 8km.

Omifimas

The *oshana* surface is often modified so as to channel water into dug out depressions alongside the water course which may be up to 5m deep. These are called *omifimas* and may hold standing water for several months into the dry season. The *omifima* is also often fenced off by those families that constructed the pits to prevent them from contamination through pollution by livestock. The walls of relatively deep *omifimas* often collapse as the water level drops and the pits have to be re-excavated before the following rainy season. There is a limit to the depth of *omifimas* as intersection with the water table could result in saline or brackish water in certain areas. A number of *omifimas* occur in the study areas, particularly in Zone B and C and these act as an important source of water for people and usually also for livestock.

Groundwater

Groundwater resources in the *oshana* area is contained in three relatively discrete compartments: a discontinuous perched aquifer, the main shallow aquifer and a deep saline aquifer (Marsh and Seely, 1992). The perched aquifer provides water of reasonable quality but limited volume. The depth of the aquifer is between 2 and 5 below the surface and may be tapped by the hand dug *omifima* if these are excavated to an appropriate depth. Prior to the construction of the Olushandja Dam such *omifimas* dug alongside the Oshana Etaka was an important source of water for the area, although some households recalled that the water was sometimes saline and the *omifimas* often dried up in the dry season. The perched aquifers require annual recharge from local rainfall and flow in the *oshanas*.

The main shallow aquifer is located within semi-consolidated sand and silt of the Upper Kalahari Sequence at depths of between 5m and 50m below the surface, and on average 20m (Department of Water Affairs, 1995). The quality of the water is variable but generally less saline towards the western edge of the Cuvelai drainage basin. According to Irving *et al* (1993) salinity varies between 400mg/l in the north-west to 1 000mg in the south-west and total dissolved solids are generally less than 5 000mg/l which is the limit barely acceptable to livestock and unacceptable to people. The main shallow aquifer is tapped by relatively deep hand-dug wells supported by timber structures. It is also recharge by rainfall events and run-off via the *oshanas*.

Sometimes a fresh water lens of recently infiltrated water exists above a more saline layer (Department of Water Affairs, 1995). These lenses are targeted as a potable source via wells and shallow boreholes. Overabstraction and progressive salt water intrusion leads to a decrease in the quality of abstracted groundwater towards the end of the dry season.

A number of hand dug wells occur to the west of the Olushandja between 5km and 10km from the dam. These are important sources of water for people and livestock who do not have access to extensive surface supplies. These wells also provided water for people prior to the construction of the dam when alternative sources dried up after the wet season. Respondents described the long distance travelled on a daily basis to fetch water up to between 5km and 10km away to the west.

The deep saline aquifer is situated at depths of more than 50m. The water is highly saline except in the extreme east and west of the *oshana* area where it is acceptable for livestock consumption. This deep aquifer may be tapped using boreholes. A number of boreholes have been drilled over the last twenty years, either by individuals, the Department of Agriculture or the Rural Development Centre. These are operated mainly by hand pumps. Some 83 boreholes were initially equipped with windmills but their performance was found to be unsatisfactory owing to the number of windless days (UNICEF, 1990). It could not be determined how many of the boreholes to the west of the Olushandja Dam were operational. Most of the boreholes in the border area have not been serviced for at least 10 years because of the war. Some also had to be taken out of production because the water was found to be unfit for human or livestock consumption.

In an inland drainage system such as the Cuvelai, the effects of salinization tend to be cumulative as salt is continually added to the system by flowing water and concentrated through high evaporation. The volume to area ratio and consequent high evaporation losses of the Olushandja Dam makes it particularly susceptible to increase in salinity levels.

Potential for exploitation of groundwater reserves is consequently limited by the quality of the water. The Olushandja Dam is thought to have a limited influence on the perched aquifer and main shallow aquifer (Department of Water Affairs, 1995). Infiltration could contribute slightly to the recharge of the main shallow aquifer in the areas directly adjacent to the dam. Water in the unlined Etaka canal leading from the south wall of the dam possibly contributes to limited recharge of groundwater reserves thereby improving the quantity and quality during the dry season (Department of Water Affairs, 1995). The impact of the Olushandja Dam on groundwater reserves has not been extensively investigated.

4.6.2 Extrinsic Water Sources

Canals and Pipelines

The Owambo bulk water supply system was designed in the late 1950's and 1960's to resolve the problem of providing a reliable, permanent supply of water to the growing towns of Oshakati and Ondangwa in the central Cuvelai district and the towns of Tsandi and Okahau to the south and south east, as well as the military camps, hospitals, mission centres etc. The bulk water system is 770km in length and consists of the unlined Etaka canal, the concrete lined Olushandja-Ogongo canal and Ogongo-Oshakati canal, the pipeline from Ogongo to beyond Oshakati with the herringbone pipeline network to

the north and the pipeline running south from Olushandja via Eunda, Onesi and Tsandi to Okahau. There are purification plants at Ombalantu, Ogongo and at the north wall of the Olushandja Dam where raw water is chemically treated.

In the vicinity of the Olushandja Dam, most of the households interviewed in Zone B relied on the Olushandja-Okahau pipeline for potable water. Those households close to the canals to the north and south of the dam depend on this supply during the dry season. The pipeline is clearly the favoured source of water as it is well known to the people that the water is purified and is less likely to cause illness.

Manholes, taps and cattle watering points are established along the length of the pipelines. These take-off points are generally poorly maintained and there is much wastage through leakages and taps left running. Attempts to rectify this situation have been made through the establishment of Water Committees with community representation. These committees are supposed to act as a mechanism for consultation between suppliers and users. Water Point Committees are responsible for minding and monitoring individual take-off points. A Regional Water Committee comprising local leaders, government officials and extension workers co-ordinates the sub-committees and defines the role of the committee system. This innovation has been a qualified success. Representation is still somewhat elitist and many of the households in the study area were unaware of the existence of such committees.

Excavation Dams

Prior to the construction of the canals and pipelines, water development in northcentral Namibia focused on the provision of excavated earth dams which became known as Stengel dams after the man who designed them. These were constructed in the *oshana* beds by excavating and building up dam walls on three sides using the excavated material. By 1971 some 320 Stengel dams, with an average capacity of 30 000m^3 each had been constructed (Department of Foreign Affairs, 1971). Such dams exist at Eunda and Onesi but cannot be regarded as an indispensable water source for the surrounding communities as the basins are largely silted up owing to poor maintenance.

Earth dams in the *oshana* beds nevertheless remain a viable option particularly for watering of livestock (Ingram, 1994). If these are excavated rather than constructed with raised walls they will not interrupt the flow of the *oshanas* and can be repeatedly flushed out to prevent the build up of brackish or saline water. If catering for livestock these dams can be constructed some distance away from inhabited zones and utilised on a seasonal basis. They would, however, still require a fair amount of maintenance.

A second type of elevated basin has also been constructed in the past adjacent to the *oshanas* from which water was pumped into the dam. The capacity of these pump storage dams varies between 6 000 and 15 000m^3 (UNICEF, 1990). Approximately 65 of these dams were originally constructed but only a few of them are still in use. One such dam occurs in the study area to the south of the dam, alongside the original Oshana Etaka.

Rainwater Collection Systems

Lack of finance for purchase of tanks and gutters are the main limiting factors to the use of rainwater collecting systems in rural areas. These have generally been restricted institutions such as schools and hospitals. These may also receive truck transported water from the Department of Water Affairs towards the end of the dry season. At two households interviewed in the study pipes had been connected for roof gutters to 200l drums for rainwater collection. This method is only viable for houses that have corrugated roofs. Most of the traditional structures have thatched roofs.

The Olushandja Dam

Dependency on the Olushandja Dam is thus limited to those families for whom alternative sources in the form of boreholes, canals or the pipeline are not feasibly accessible. The dam is the most important source of water for households within a distance 2km from this supply. In Zone A, 23 of the 30 households interviewed were dependent on water from the dam during the wet season compared 6 households of those interviewed in Zone B, and only 3 in Zone C who occasionally collected water from the dam. Collection of water is largely the responsibility of the women or children and containers used vary between 5 and 20 litres. The number of times a day water is collected depends on proximity of the homestead to the dam as well as the size of the container used, but is seldom less than two or three times a day. The dam water is used for washing, drinking and cooking. Clothes are usually washed in basins alongside the dam so as to prevent pollution of the water.

Respondents to the household questionnaires expressed concern about the quality of the dam water. Pollution and turbidity were attributed to livestock defecating and wading in the shallow waters along the banks and the use of drag nets by fishermen. Although water is seldom boiled, it may be left standing so that material in suspension may settle. The settling out process may be facilitated by the addition of ash to the water. The chief benefit of the dam is perceived as being its dual function as a water source for both people and livestock.

5 IMPACT IDENTIFICATION AND EVALUATION

5.1 Defining impacts in a developing context

Early definitions of impacts relating to affected communities, in response to NEPA legislation, focused almost solely on socio-economic factors such as demographic changes and employment opportunities. Such effects were readily quantifiable and easily calculated using well understood techniques (Bisset, 1984). Study results could also be clearly communicated and appreciated by decisionmakers. In developed countries, such investigations can be equally as easily accepted or rejected by impacted social groups since all interested and affected parties share similar values and education standards. SIAs in African countries, often supported by foreign aid and undertaken by outsiders, cannot successfully avoid conflict and misunderstanding if the same definition of impact is applied.

A definition of social impacts is considerably more complex in a developing context. Bisset (1984) defines social impacts as those changes in social relations between members of an institution, community and society resulting from external change. This definition would appear to exclude the crucial interrelationship between people and their natural environment, characteristic of subsistence economies in developing countries. The Guidelines and Principles for SIA compiled by an Interorganisational Committee describe social impacts as the consequences to human populations of any public or private actions that alter the ways in which people live, work, play and relate to one another, organise to meet their needs, and generally cope as members of society. Their definition also includes cultural impacts involving changes to the norms, values and beliefs that guide and rationalize people's cognition of themselves and their society. This broad interpretation recognises the need to appreciate and understand the values, priorities and cultural norms of the affected social groups. It also takes cognisance of people's dependence on their social and natural environment to "meet their needs."

According to this definition of social impact, assessment must extend beyond the evaluation of physical manifestations of the consequences of a project action, to include investigation into psychological perceptions and value systems. Fuggle and Rabie (1992) distinguish between first order or primary impacts and secondary or induced impacts. A primary impact is an effect that arises from a cause directly related to the project, whereas secondary impacts are those which arise from an action, but which are not initiated directly by that action. Primary and secondary impacts may be either physical or perceptual. Both are equally real and require evaluation and mitigation based on a sound knowledge and appreciation of the unique cultural and social attributes of the society in question.

The Terms of Reference for the present study require the social assessment team to investigate, identify, evaluate and report on the social effects of the envisaged water supply upgrading project. The Department of Water Affairs have expressed their intention to maintain the dam at full storage capacity thereby creating a two month surety of supply in Namibia, should the transfer of water from Angola be curtailed. According to Haussler (1995) "Calueque must operate without interruption and all excess water

discharged into the Olushandja Dam". Figure 8 illustrates the full supply level in relation to the present capacity and the recommended limit of settlement at the time of dam design.

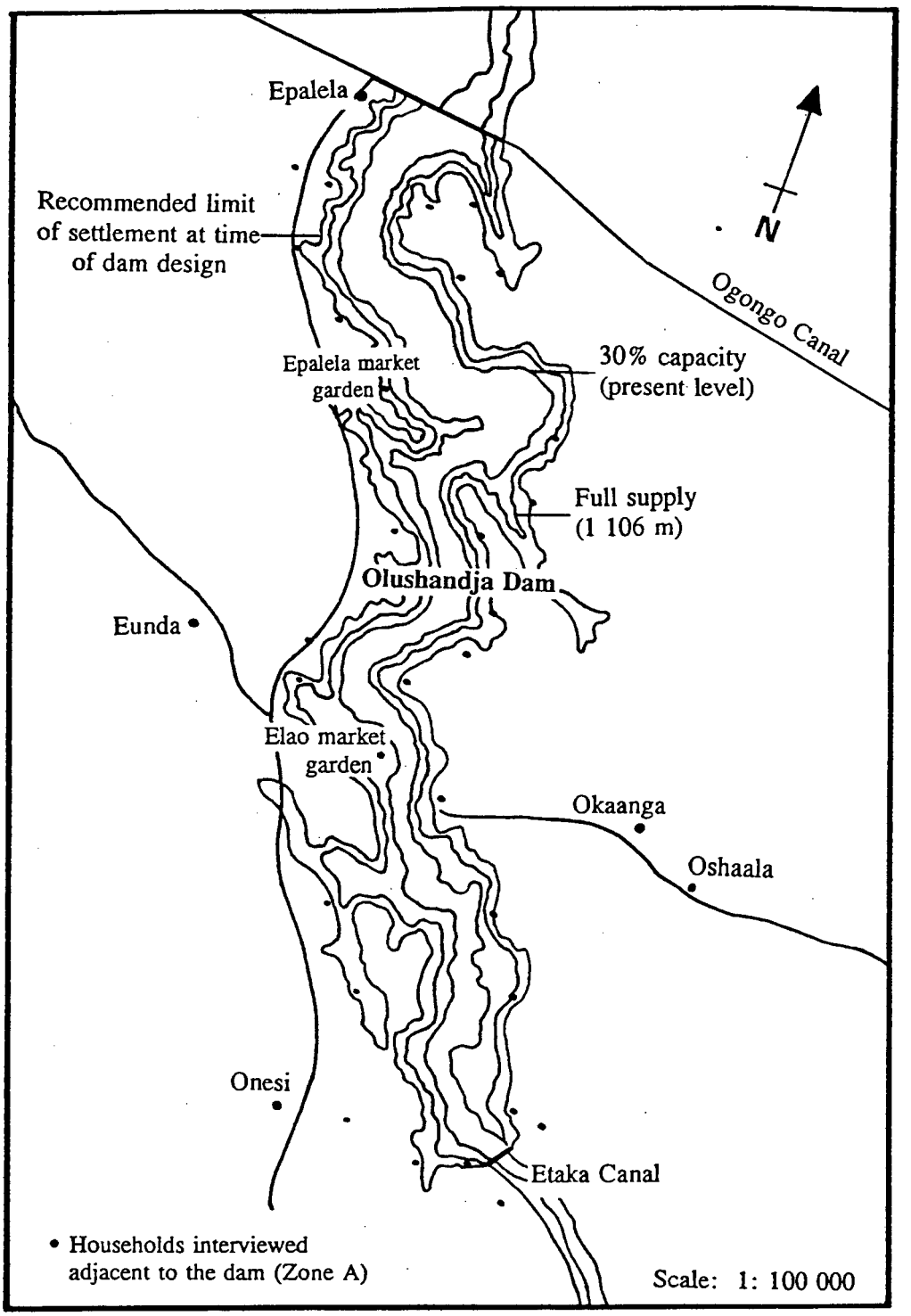


Figure 8: Contours representing present dam level, full supply and the recommended limit of settlement

Impacts of the upgrading of the Olushandja Dam may be expressed in terms of identified social assessment variables. Because the dam already exists a comparison of impacts associated with alternative ways of storing and distributing water from the Cunene River is not required. Although it may still be possible to consider the "no go" or "take no action" alternative to the upgrading scheme, this was not considered realistic or feasible in the light of regional water requirements along the canals and pipelines. Furthermore, the pumps of the required capacity have already been installed on the Namibian side of the border.

The present investigation identifies two scenarios that could affect the water level of the Olushandja Dam. A scenario is defined by Finsterbusch (1985) as providing a narrative description of potential courses of development by sketching a logical sequence of events. By describing the possible future consequences of an action or event, scenarios can apprise decision makers and potentially affected parties of the possible costs and benefits of an action as suggest steps for preventing or mitigating undesirable consequences. In the evaluation that follows scenarios are treated as consequences of a set of controllable or uncontrollable variables as opposed to alternatives, since these are not always subject to rational choice on behalf of the decision making authority.

In a discussion of the environmental evaluation requirements of developing countries Fuggle (1991) warns against reactive EIAs or SIAs that are limited to identifying ways of mitigating negative impacts, and consequently appear to be little more than justifications for the proposed action. However, when projects require external financial aid, and are subject to approval on the basis of an environmental assessment, the assessment is inevitably viewed as a form of justification through the eyes of the relevant government authority. It remains the responsibility of the assessment team to improve the intelligence capacity of the decision-maker and act as an information broker to all the affected parties. Although far from ideal, the SIA is not invalidated. Its function is somewhat modified and there are certainly limits to what may be achieved. The situation characterised by this SIA is, nevertheless, a common problem in developing countries. A substantial degree of flexibility is required in approaches to SIAs and EIAs before authorities recognise the value in a more rigorous application of the principles and procedures of initiatives such as IEM.

5.2 Impact Identification

The two scenarios can be simply regarded as the need to store water in the Olushandja Dam on the one hand, and the need to extract water from the dam on the other.

The need to pump water from the Olushandja reservoir will be subject to the occurrence of one or more events, which may either be pre-determined (controlled) or unavoidable (uncontrolled). Controlled events would include curtailing pumping activities from Calueque in response to routine services of pumps and equipment or scheduled infrastructural repairs.

Unavoidable happenings which might interfere with the transfer system would include:

- a drop in the flow of the Cunene River below that required for water to be channelled to the pump-station.
- conflict related activities in Angola which may lead to infrastructural damage or destruction as it has done in the past
- unforeseen mechanical breakdowns.

Any of these events may necessitate the drawing down of the Olushandja storage dam to maintain supply along the canal and pipeline network. The level to which the dam is drawn will depend on the time it takes to re-instate the transfer system. Scheduled repairs and breakdowns are unlikely to result in the suspension of pumping activities for more than a few days, particularly as the installation of one complete standby pump unit with a capacity of $3m^3/s$ will guarantee 50% surety of supply. Destructive activities or the effect of prolonged periods of drought on the flow of the Cunene, could well necessitate the drawing down of the Olushandja Dam to dead stock.

In the light of the above and the intended function of the Olushandja Dam, three alternative management plans can be proposed. According to Fuggle and Rabie (1992) these may be regarded as a combination of activity and temporal alternatives since both the timing and associated actions will be important in the implementation of either alternative. The three strategies described below were identified on the basis of advice from specialist consultants and engineers. They are aimed at maximising the benefits of the upgrading scheme, without undermining the storage function of the dam, between such times that it may be necessary to exploit this reserve supply. The relationship between scenarios and management alternatives is illustrated below (Fig. 6).

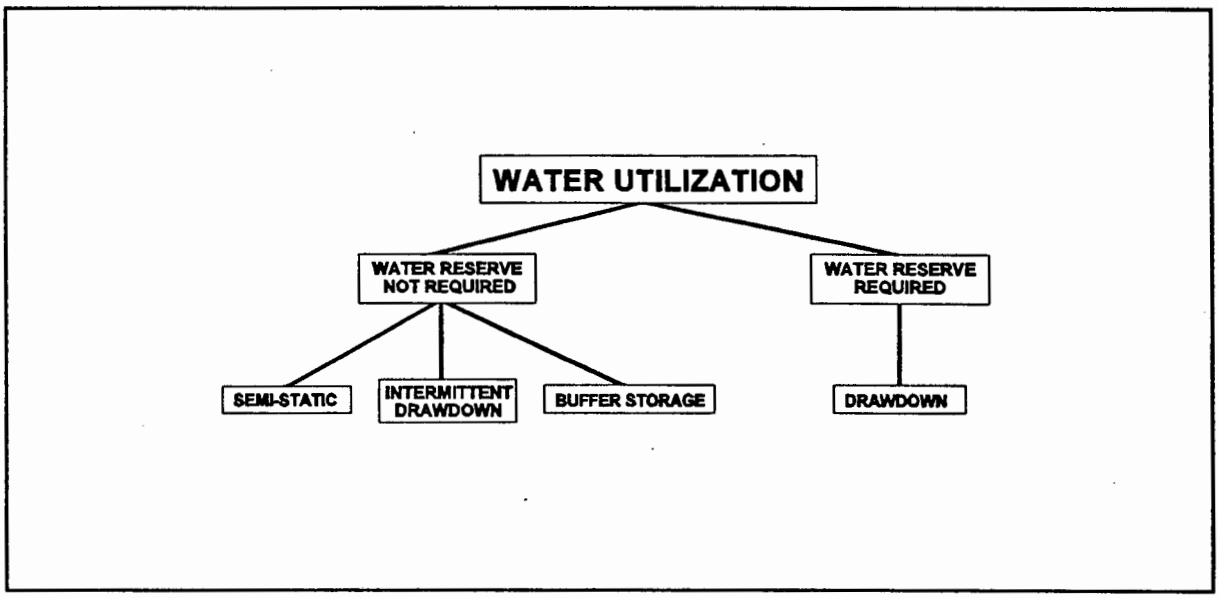


Figure 9: Scenarios for the management of Olushandja Dam

A detailed investigation of the frequency and duration of the various controllable and uncontrollable causes of drawdown is beyond the terms of reference of the current study.

The discussion of potential primary impacts resulting from the alternative management strategies identified below is organised around six components of the social environment derived from the previously defined social assessment variables. The following categories include all those environmental factors which may be directly affected by development actions. These categories have been identified in conjunction with the checklist of environmental characteristics for IEM (Department of Environment Affairs, 1992). More importantly, they are designed to reflect and acknowledge the main environmental concerns expressed by the communities during household interviews and the PRA workshop.

- Health and well-being
- Fishing activities
- Water quality and accessibility
- Settlement and housing
- Community organisation and movement patterns
- Silvipastoral farming

The discussion of impacts will relate to three sequential stages, beginning with a brief review and evaluation of the impact of dam construction. The initial project action and last stage, raising the dam to full supply and drawing it down to dead stock, can be regarded as inevitable components of the upgrading scheme. The latter will take place in response to the occurrence of one or more events or scenarios, which may or may not be subject to rational decision making. Interim management will involve the selection of suitable strategy for maximising benefits and minimising negative impacts. The discussion of positive and negative impacts of the various stages and alternatives reflects the interdependent relationship between the social and biophysical impacts of the upgrading scheme.

5.2.1 Primary Impacts

5.2.1.1 Impacts associated with dam construction

A number of impacts were effected as a direct result of dam construction. A brief discussion of these comprises an evaluative component of the SIA.

Health and well-being

Spread of parasitic diseases. Impoundment of water in the Olushandja Dam had the effect of creating new habitats and favourable conditions for the establishment of intermediate host organisms, in the form of mosquitoes and snails.

Three snail species of medical or veterinary importance occur in the Olushandja Dam (Curtis, 1995). Of these, *Bulinus globosus*, intermediate host for urinary bilharzia, is most common in the northern part of the dam, particularly in the immediate vicinity of the water inlet from the Calueque-Olushandja canal (Curtis, 1995). This snail has been previously recorded in the Cunene River and would seem to have been transferred to the new habitat created by the presence of the Olushandja Dam. Fewer species of *Biomphhalaria pfeifferi*, intermediate host for intestinal bilharzia were detected, and the occurrence of this disease is yet to be recorded in the area *Lymnaea natalensis*, the intermediate host for liverfluke, was also found to occur near the north wall of the dam (Curtis, 1995). The occurrence of liverfluke has an indirect effect on the social environment by infecting and often causing the death of livestock, thereby detracting from people's wealth and status in the community. Liverfluke may also affect people directly if the aquatic plant bearing the parasite is eaten (Curtis, 1995).

Although malaria is still regarded as the most severe health problem in the area, clinic staff in the study region reported an increase in incidences of bilharzia in recent years. It is not a common disease affecting people in other parts of Owamboland since only the intermediate host for schistosomiasis in livestock can withstand long dry periods between floods (Curtis, 1990). The vegetated margins of the dam, on the other hand, provide ideal habitats for trematode hosting freshwater snails. Once a cycle of infestation has been initiated, the disease spreads rapidly as the eggs of parasites in the form of adult worms are excreted in urine or faeces. On coming in contact with water, the eggs hatch and the parasite locates and penetrates another snail host. After several weeks of growth, the parasite is gradually shed. On location of the definitive mammalian host, they actively penetrate the skin and make their way to the blood vessels and tissues of the infected person (Curtis, 1995). Bilharzia patients are not always treated at the local clinics. Severe cases are usually referred to hospitals in Oshakati or Ombalantu.

Unlike bilharzia, malaria is a common disease throughout Owambo. It is generally associated with the wet season when large numbers of *Anopheles* mosquitoes breed in standing water (Marsh and Seely, 1992). The Olushandja Dam, however, acts as a permanent breeding ground and consequently people in the area are susceptible to contracting malaria at any time of the year. Thousands of people are treated for malaria annually in the study area. There has, nevertheless, been a fortunate decrease in incidences of malaria, attributed by clinic staff to the launch of a nationwide awareness campaign, promoting the use of preventative techniques such as mosquito nets and sprays.

Even though malaria and bilharzia are certainly the most common infestations associated with the Olushandja Dam, other water borne diseases may well occur but not be reported. The spread of filariasis is commonly accelerated by water impoundments in subtropical countries. The symptoms of this disease in the form of rashes and swelling were described by two of the respondents during household interviews.

Although treatment is available for these parasitic diseases, hospitals and clinics are relatively inaccessible, particularly for residents on the east side of the dam. The Oshaala clinic is only open on certain days of the week and few families have transport to the clinics on the west side at Eunda and Onesi. At present none of the local clinics have facilities to admit overnight patients.

Gastro-intestinal illnesses. A number of more minor, but equally debilitating illnesses may be directly attributed to the consumption of raw water from the dam and canals. These include gastritis, dysentery and diarrhoea, particularly amongst children. The shallow water from where people draw their daily supplies is generally polluted by livestock and human faecal matter, sediment stirred up through fishing activities, glass and plastic pollution and people bathing and washing clothes, although the latter is generally discouraged. Water samples collected by Roberts (1995) at sites utilised for these activities, showed coliform bacteria indicative of bacteriological contamination.

Households have been encouraged by clinic staff and extension workers to boil raw water prior to consumption. But as mentioned previously, few people are inclined to undertake the necessary effort in terms of additional time and resources. The frequency of occurrence and severity of these illnesses determines whether or not treatment is sought. During the household interviews it became apparent that those respondents and their children were resigned to suffering some degree of gastric pain and discomfort.

Fishing activities

Fish production. As for snails and mosquitoes, the construction of the Olushandja Dam created a permanent habitat and spawning area for fish stock. According to Hay and Van Zyl (1995) 16 new fish species, in addition to those recorded on an annual basis in the Cuvelai system, have been introduced into the Olushandja Dam via the canal link to the Cunene River. The dam is consequently responsible for a considerable increase in ecological diversity. Not all of these species have direct benefit for the surrounding communities as catches are limited to barbel and tilapia species. There is nevertheless a biological inter-relationship between these and other species as well as the limnological conditions in the dam. A permanent supply of fish provides a valuable source of income for some and forms an important source of protein in people's diets.

Water accessibility and quality

Secure water supply. Because water is the single most important limiting factor in Owambo, large scale dam construction inevitably has a significant local and regional social impact. The Olushandja Dam provided residents in the study area and those along the canal and pipeline system with a permanent water supply. Prior to dam construction, people depended on *omifimas*, stengel dams and hand dug wells in the dry season, and the pans and *oshanas*, including the Oshana Etaka, in the wet season.

Water dependence has subsequently shifted to the Olushandja Dam. 80% of the 30 households interviewed within 2.5km of the dam depended entirely on this source of water in the dry season, compare to 25% in Zone B. Aerial photographs indicate that a total of 1 325 households are situated within 5km of the dam in Zone A and B. Although the sampling technique used in the survey was indicative rather than statistically representative, it can be safely estimated that over 500 households representing

approximately 4 000 individuals utilise the dam for multiple purposes, including washing, drinking, watering of livestock and cooking.

Settlement and Housing

Induced settlement. It has been established that the presence of the Olushandja Dam did not have a marked effect on settlement patterns in the area. Dam construction did not seem to induce settlement and it soon became associated with the spread of disease and gastric-intestinal illness. Furthermore, few people have exploited the irrigation potential of the dam. Settlement distribution is largely determined by the availability of land and location to infrastructure and family.

Inundation of fields and homes. One respondent to the household questionnaire recalled that approximately three families were warned that their *epyas* (fields) or *egumbos* (households) would be affected by the impoundment of water. At the time of dam design, the full supply level was defined at 1 106m a.m.s.l as well as a second contour indicating the recommended limit of settlement (1 107.5m a.m.s.l). From the responses during household and key informant interviews, it can be inferred that the dam has seldom been more than 30 to 50% full since construction was complete in 1974. Thus the line defining the recommended limit of settlement which, according to the DWA, was demarcated with stones, could not be regarded as a credible recommendation through the eyes of the community.

Patterns of community organisation and movement

Disruption of human movement patterns and community organisation. In general, Owambo communities are well adapted to the *oshana* system. They cope adequately in times of flooding since the *efundja* phenomenon is recognised as an inevitable and vital function of the natural environmental system. The Olushandja Dam represents a significant modification of this system, in that it is a permanent rather than ephemeral manifestation. The sequence of events associated with the *oshanas*, including renewal of grazing and other resources, no longer occur. Significantly, the disruption of visiting patterns and the inconveniences related to mobility, are also no longer temporary.

Infrastructure and services are concentrated on the western side of the dam in the settlements of Eunda and Onesi. These places represent the original nodes of settlement and are characterised by dense permanent settlement and well established households. A number of people now living in Zone A and Zone C were raised in the vicinity of Eunda or Onesi and have strong family ties to these settlements. The presence of the Olushandja Dam has isolated those families on the eastern side of the dam for whom churches, clinics and family residences are no longer accessible. The regional community is less interactive and social groupings have changed to reflect that side of the dam on which people live. Desperate attempts to access facilities on the opposite side of the dam have resulted in a number of drownings by people trying to walk across the dam.

Transhumance. After harvesting, at the onset of the dry season, it is traditional practice to send cattle herds on *ohambo* to outlying areas to the east and west of the central floodplain and into Angola. Important cattle posts with supplies of borehole water and grazing, are situated 10 to 30km west of the Olushandja Dam. Impoundment of this 19km water body in the early 1970s would have influenced access to cattle posts to the west of the dam. At this time there was a general disruption of transhumance practices with the construction of the canals, trenches and pipelines comprising the bulk water supply network. Although communities and their cattle are becoming increasingly sedentary as a result, a number of livestock are still taken on *ohambo* annually, accompanied by children or hired herders. The negative impact on livestock mobility of the Olushandja Dam is partially mitigated by the importance of the dam as a watering hole *en* route to cattle posts in the west.

Silvipastoral farming

Inundation of *mahangu* fields. It would appear from the household interviews that few *epyas* were subject to inundation at the time of dam construction when the entire region would have been considerably less densely populated. The fields of several houses were, however, observed to be flooded after heavy rain fell prior to the household survey exercise, as were portions of the market gardens. These areas have to remain uncultivated.

Inundation of communal resources. Communal areas for grazing and natural resource exploitation were flooded when water was initially impounded in the dam. Hundreds of stumps visible in the shallow waters of the dam are indicative of the number of trees subjected to inundation. According to the limnological specialist report (Roberts, 1995), filling of the dam flooded several forests of particularly large Mopane trees growing on the richer alluvial soils along the inner bends of the original Oshana Etaka, as well as numerous acacia species. These trees would have been a source of fuel and construction material. Cattle and smallstock also forage on parts of woody vegetation, including the seedpods of acacia species and the leaves of Mopane trees.

Loss of *oshana* bed grazing. A further negative impact of dam construction on agriculture, was the loss of the seasonal supply of *oshana* bed grazing associated with the original Oshana Etaka. This availability of grazing was the primary motivation for the return of cattle to the area from cattle posts in the west. Since dam construction, a number of herds are permanently stationed in the west, despite the permanent presence of water in the dam. The supply, nevertheless, acts as a valuable drinking hole *en* route to the cattle posts for those herds travelling from further east.

Irrigation potential. The use of the dam for irrigation purposes has been largely restricted to the market garden initiatives both of which use solar driven pumps to transfer water from the dam into tanks from which they irrigate using drip and flood mechanisms. Only one other household, belonging to an Angolan refugee, was equipped with a pump system to enable crop and vegetable cultivation through out the year. There was some evidence of attempts to dig channels to divert water from the dam to households, but

these efforts did not seem to adequately maintained to be successful. Respondents expressed an interest in irrigation, but lacked the financial means to effect their ideas. Others did not have an adequate grasp of this concept which proved difficult to explain through the use of examples owing to the discrepancy in the spray techniques employed at Etunda as opposed to the market gardens.

5.2.1.2 Impacts associated with raising the water level to capacity (1106m a.m.s.l)

Health and well-being

Spread of parasitic diseases. Raising the water level to full capacity, will considerably enlarge the breeding area for bilharzia and malaria vectors, and extend the shallow aquatic contact zone between parasites and their mammalian hosts around the margins of the dam. Local populations will be submitted to a higher risk of infestation.

Gastro-intestinal illness. The raising of the water level to full capacity is not likely to seriously exacerbate gastric illnesses. More people may be affected if dam water became available to an increased number of households. It is, however, unlikely that people within reach of dam water and the pipeline, will choose to collect water from Olushandja even if this supply became more accessible.

Fishing activities

Size of catches and fish production. Raising the level of the dam is likely to have little effect on fishing activities. Initially there may be a decrease in the size of catches with an increase in the size of the dam as the number of fish per unit volume is decreased. This effect will be marginal and may only be evident in a slight reduction in net catches. According to Hay and Van Zyl (1995), the increase in volume of water may improve fish production and equilibrium conditions will soon be reached. An initial increase in water flow into the dam, as the level is raised to full supply, will be beneficial in terms of aeration and oxygen supply.

Water quality and accessibility

Improved accessibility. Raising the dam to full capacity should not significantly affect the number of people utilising this supply, particularly as a number of respondents indicated that the dam was not necessarily a preferred source of water for drinking purposes. The dam will become only marginally more accessible to households as they might have several metres less further to walk to collect water.

Increased turbidity levels. High turbidity levels are attributed to a combination of shallow depth, silt deposits, phytoplankton and wind action. Cunene water fed into the dam to raise the level to full capacity, is also often silt laden (Roberts, 1995). Additional flow into the dam is unlikely to significantly reduce turbidity levels.

Increased salinity. At present, sodium concentrations in the dam are detectable but not excessive in terms of the recommended concentrations for human consumption. The initial effect of raising the dam level to full capacity will be to further dilute these concentrations. However, by doing so, conditions most favourable to high evaporation loss are created.

Settlement and housing

Induced settlement. Since the initial impoundment did not appear to induce settlement, it is unlikely that consistent maintenance of the dam at full supply will significantly affect settlement patterns unless large irrigation or fishing project are introduced as a means of maximising benefits.

Inundation of fields, homes and market gardens. From the analysis of aerial photos flown in May 1995, it could be established that 30 households and their surrounding fields will be inundated by the raising of the dam level to full supply. These households are situated below the 1 106m contour. The market gardens of Elao and Epalela on the western side of the dam will also be flooded A total of 71 households were identified below the line of recommended limit of settlement, i.e.: between 1 106 and 1 107.5m a.m.s.l. These households are likely to be marginally affected by wave action during storms and high winds, which occur infrequently in the study area.

Patterns of community organisation and movement

Disruption of human movement patterns and social organisation. Maintaining the dam at full capacity will have minimal affect other than to compound disruption of social organisation already caused by dam construction. A few metre section of the road running parallel to the west bank falls below the 1107.5m a.m.s.l contour. Vehicular mobility may be affected in high weather conditions, but the impact should not be more severe than that resulting from good rains in the wet season.

Transhumance. Although livestock movement between the floodplain and cattle posts is less than it has been in the past, herds are still sent on *ohambo* from the eastern side of the dam. Raising the dam to full capacity will further limit accessibility to cattle posts in the west.

Induced psycho-sociological stress. Psychosocial impacts are those that affect an individual's psyche related to social environmental conditions. An increase in the surface area of water could also have the psychosomatic effect of increasing the perceived distance across the dam thereby increasing psycho-social stress levels among community members, particularly on the eastern side of the dam.

Silvipastoral agriculture

Inundation of *mahangu* fields. Subsistence agriculture will be directly affected in those cases where household fields are flooded by an increase in the level of the dam. These fields will be permanently

inundated if the dam is maintained at full supply, negatively impacting potential agriculture production capacity of households. In a number of cases, fields will be only partly inundated. In reality, few families, especially female headed households, utilise the full extent of their *epyas* for crop production due to amount of labour required for this intensive form of subsistence farming. Nevertheless, what could be regarded as option value, will be decreased.

Inundation of communal resources. Increasing the dam to full capacity will lead to further inundation of communal land. At present the vegetation surrounding the dam is heavily overgrazed, subject to severe trampling, and overutilised for fuel wood and fencing. Composition is consequently changing to comprise few low-growing, unpalatable species (Burke, 1995). The water level at full capacity will not reach the natural Mopane woodlands. Thus, the impact on natural resource utilisation and tree tenure will not be severe.

Irrigation potential. An increase in volume of water may the improve potential for small scale irrigation of fields and vegetable gardens by bringing the dam and additional households into closer contact. A number of respondents in the household interviews expressed an interest in the type of irrigation used at the market gardens. The realisation of irrigation potential will be largely determined by water quality and management.

5.2.1.3 Interim management strategies

Alternative 1: Management of the dam as a semi-static reservoir

The existing dam basin has a surface area of 26.0 x $10^6 m^2$ at the full supply level corresponding to 1106 m a.m.s.l. The corresponding capacity is 42.29 x $10^6 m^3$ and the surface area to capacity ratio is therefore 0.61m^2/m^3 (Lund, 1992). This poor surface area to volume of water stored ratio results in exceptionally high evaporation losses. These amounts have been calculated by Lund (1992) using the relevant evaporation loss tables for the Mahanene Research Station obtained from the weather bureau in Windhoek. Average monthly evaporation from the surface of the dam is approximately 140mm. Losses are highest in October and November (approximately 200m) when ambient conditions are characterised by high temperatures and low humidity at the end of the dry season. Evaporation losses are considerably lower in February - March as rainfall and humidity levels increase. Mean annual evaporation varies between 1 660 and 2 500mm (Lund, 1992; Marsh and Seely, 1992).

Management of the dam as a semi-static reservoir would entail raising the dam to full supply level and maintaining it at this level. This would be achieved by only compensating for total amount lost to evaporation and the 1m^3/s of water gravity fed or pumped into the Etaka Canal via the south wall outlet works. The amount of Cunene water supplied to the dam via the canal will thus vary slightly on a monthly basis.

Maintaining the dam at full capacity will maximise the amount of water lost through evaporation. This is as a function of poor area to volume ration and the cross-sectional profile of the dam basin which reflect gently sloping margins with a marked increase in depth towards the centre. (Figures)

Alternative 2: Buffer Storage

The existing pumping equipment at the north and south wall of the dam, is at present used only to augment water supply from the dam. The north wall pump-station has been equipped with two new pumps with a combined capacity of 3.2m^3/s. A complete "dry" standby set is provided in the event of breakdowns. Water is currently fed into the Olushandja-Ogongo canal directly from the Calueque-Olushandja canal via an inverted syphon under the dam, parallel to the north wall. Only a supplementary supply into the Olushandja-Ogongo canal is ever pumped from the dam. Similarly the two pumps at the south wall, with an operating capacity of about 350 - 400 l/s each, are utilised only when the dam level drops below 1104.6masl (approximately 35% of capacity) and water cannot be gravity fed into the Etaka canal.

Management of Olushandja as a buffer storage dam would require the utilisation of full pumping capacity at the north wall. The Olushandja-Ogongo canal would consequently be supplied from the dam itself rather than the Calueque-Olushandja canal. As opposed to largely static system described for Alternative 1, there will be a continuous exchange of water, as the supply from the Cunene is drained directly into the dam through an existing outlet structure in the syphon, and pumped from the dam into the supply network. The dam will still be maintained at full capacity but instead of being largely by-passed at this stage, it will function as a temporary or buffer storage facility for regional water supplies to the east as well as the south. The 1.3m^3/s that will be initially required by the North-western Owambo Irrigation Scheme at Etunda, will be diverted from the Calueque-Olushandja canal which crosses the border west of the dam, closer to Etunda. It is thus unlikely to be economically feasible to temporarily store the Etunda component in the dam. The design construction of a diversion canal is currently under consideration.

Mixing in the vicinity of the north wall will be enhanced mitigating against the build up of non-volatiles. Positive effects will be enhanced by the fact that Cunene water will be released from an outlet in the syphon at the base of the dam whereas surface water will be pumped into the canal.

Alternative 3: Blow-down strategy

A blow down strategy is a commonly used management technique used to combat the effects of static/dead storage. This management option would combine the operations described in alternative 1 and 2. The dam will be maintained as a static reservoir subject to a consistent and comprehensive monitoring program. Every four or five years depending on the results of the monitoring program, the level will be blown-down to approximately 50% of full capacity, through by-passing the syphon and pumping water

directly from the dam for a limited period of time. Close to 50% of capacity is likely to be represent an optimum between immediate negative consequences for surrounding communities and enhancing the long term positive benefits, although this will have to be subject to the results of the monitoring program discussed below. The strategy will result in planned fluctuations in water level in addition to fluctuations necessitated by unforeseen events on the Angolan side of the border. Foreseen events, including service and maintenance operations in Angola and along the Calueque-Olushandja canal, can be arranged so as to coincide with regulated blow down events at the Olushandja Dam.

Blow downs will ensure extensive mixing and partial water renewal down the entire length of the dam.

Impact associated with each of these management strategies are described.

Health and well-being

Spread of parasitic diseases. *Alternative 1*: Management of the dam as a semi-static reservoir is likely to encourage the spread of disease. The limited amount of water fed into the dam to compensate for evaporation losses and the water that is gravity fed into the Etaka canal, will not significantly alter the flow regime near the north wall. Standing water acts as the most ideal habitat for disease spreading vectors.

Alternative 2: Intermediate snail hosts for urinary bilharzia and liverfluke are presently concentrated in the vegetation along the north wall close to the water inlet from the Calueque-Olushandja canal (Curtis, 1995). The snails are thus being transferred from the Cunene River into the dam and establishing themselves in the marginal vegetation associated with the relatively static shallow water at the northern wall. The buffer storage management option will have a dual impact. It could possibly encourage the transfer of snails from the Cunene by allowing for the transfer of canal water directly into the dam. But it may mitigate against the creation of suitable breeding areas by enhancing circulation close to the north wall as water is continuously pumped into the Olushandja-Ogongo canal.

Alternative 3: Snails are largely associated with the flowering aquatic plant, *Ludwigia stolonifera*, a dominant angiosperm present along dam margins in the northern section. Other favoured plants include broad-leafed water lilies and floating mats of terrestrial grass. These provide food and shelter for snails (Curtis, 1995). Snail numbers generally decline further to the south with the exception of an area of moderate density of the *Bulinus globosus* species among abundant aquatic vegetation approximately 8km south of the north wall.

Drawing the dam down to 50% of its capacity could expose infested aquatic vegetation throughout the dam to dry conditions for a period of time sufficient to prohibit the survival of these plants. Prolonged dry periods is what prevents most snail hosts from infesting the ephemeral pans and *oshanas* (Curtis, 1995). Unfortunately *Ludwigia stolonifera* is a floating aquatic plant capable of drifting with fluctuating water

levels to some extent, although it does have to be rooted in some form of substrate (Curtis, 1995). If blow downs do not create conditions suited to the elimination of the invested vegetation, they should at least facilitate the manual removal of these species.

The alternative management strategies will have little impact on the spread of malaria, although the more static conditions may encourage breeding of malaria carrying mosquitoes.

Gastro-intestinal illness. Choice among the alternative management strategies is unlikely to significantly affect the occurrence of gastric illnesses. *Alternative 3* may mitigate against coliform bacteria eutrophication, by encouraging extensive mixing every few years through regular renewal of a significant portion of water throughout the dam.

Fishing activities

Size of catches and fish production. *Alternative 1:* Management of the dam as semi-static reservoir at full capacity should not have a considerable impact on fishing activities, although the zone of shallow water close to the dam margins will be extended making the deeper water in the middle of the dam less accessible to fishermen. The cumulative effect of increasing salinity levels associated with high evaporation is unlikely to seriously affect consumable fish stock as both barbel and tilapia are resilient species, endemic to southern Africa. Barbel particularly, are well adapted to turbid waters (Day, 1995b).

Alternative 2: The improved circulation and aeration of water will have a favourable impact on fish stock in the northern section of the dam. Tilapia prefer slightly higher flow rates than barbel and may therefore congregate closer to the north wall. The direct and continuous transfer of water into the dam from the canal may increase the likelihood of species transfer between the dam and the Cunene River. The ecological consequences of this are likely to be more signifcant tsignificantcial impacts as catches are generally restricted to one or two fish species.

Alternative 3: The blow down approach to dam management will not hold significant impact on fish stock. Although an increase in volume of water may initially lead to increased fish production, the opposite is not likely to occur when the dam is blown down to 50%. Species such as barbel and tilapia do not require consistently large expanses of water. Provided food supply is not jeopordised, these fish will easily adapt to a more crowded living space. Blow down to 50% will not will not have much affect on plant and nutrient related food supply for tilapia and other species, and will have no impact on food supply for barbel as these are a predator species.

Blow down periods are likely to be characterised by improved net, line and basket catches as the number of fish per unit volume of water increases.

Water quality and accessibility

Improved accessibility. There is little discrepancy between *alternative 1 & 2*, the impact on accessibility will basically be that of raising the dam to full capacity. *Alternative 3* entailing drawdown to 50% may affect accessibility every few years - for a limited period of time people may have further to walk to the dam. An extensive muddy area could be created, particularly in the wet season, but high temperatures and generally dry ambient conditions in combination with light winds will rapidly desiccate the soil. The effect will be very similar to that associated with the drying up of pans and *oshanas* at the onset of the dry season.

At present, with the exception of the market gardens, few attempts have been made to channel water from the dam to households, whether it be for consumptive or irrigation use. Maintenance of the dam at full capacity as for *alternatives 1 & 2*, will make dam water more accessible to additional households who may be encouraged in attempts to transfer water from the dam via pipes or channels. In this event, intermittent blow downs as for *alternative 3*, will hinder the operation of such endeavours. This impact is mitigated by the fact that such blow downs may only occur once every few years.

Increased turbidity levels. Management of the dam will have little effect on turbididty whichever alternative is implemented. Turbidity is attributed largely to wind action and phytoplankton combined with shallow depths of the dam. Maintenance of the dam at full capacity will not significantly increase the depth of the dam due to the exceptionally flat landscape (an average gradient of 1:1000 - 3000). Management strategies will not influence the factors contributing to turbid conditions and water fed into the dam from the Cunene is often silt laden. A blow down to 50% will not lead to a marked concentration effect on suspended material.

Increased salinity. *Alternative 1:* Management of the dam as a semi-static reservoir will lead to high evaporation losses and a significant increase in salinity levels. Physiologically, black people are characterised by vulnerable sodium exchange systems (Guyton, 1991). They may consequently be relatively salt sensitive and prone to hypertension, although this is more common in urban as opposed to rural black people. Livestock have a high sodium tolerance levels. The present sodium concentration in the dam is not excessive and within limits for drinking water defined by the Water Quality Division of the Department of Water Affairs. The levels were nevertheless higher in relation to other Namibian dams (Roberts, 1995). A wet season average of 12.47 ppm with a maximum of 41ppm was measured by Roberts (1995). Concentrations are likely to be considerably more in the dry season.

Alternative 2: Continuous extraction from the dam to the canal and purification works and "freshwater" replacement from Cunene, will mitigate against the local build up of excessive saline concentrations. This effect will be greatest in the northern section of the dam which is used extensively by people to wash, swim and fish. Residents of Epalela township rely on water near the dam wall for drinking and cooking. Improved flow and circulation will also enhance the quality of water for consumption.

Alternative 3: Alternating static conditions and draw down will mitigate against the cumulative build up of sodium. Salinity levels will vary from medium to low across the extent of the dam. Evaporation loss will decrease with a decrease in ratio of surface area to volume associated with draw down. Salinity concentrations throughout the dam will be considerably diluted as the level is raised by the transfer of "fresh" water from the Calueque-Olushandja canal.

Settlement and housing

Induced settlement. Since settlement has not been induced by the presence of the dam, variations in water management is not likely to affect population distribution and patterns. However, associated schemes for maximisation of benefits and opportunities that may be implemented, could attract people to the study area.

Inundation of fields, homes and market gardens. Beyond inundation caused by the initial rise in the level of the dam, alternative management strategies will not have further impact on household and market garden infrastructure.

Patterns of social organisation and movement

Disruption of human movement patterns and social organisation. Whichever management strategy is implemented will not serve to increase or decrease community mobility. Drawdown to 50% as for *alternative 3* will not make the dam easier to cross as the maximum depth will remain the constant.

Transhumance. Likewise, dam management operations will not further impact on transhumance practices. Implementation of *alternative 3* may slightly reduce the impact during blow downs as cattle posts become marginally more accessible.

Silvipastoral farming

- **Inundation of *mahangu* fields, market gardens and communal resources.** Maintenance of the dam at maximum capacity as for *alternative 1 & 2* will result in permanent inundation of productive land Intermittent drawdowns to 50% will expose previously inundated land for a limited period. According to Burke (1995) a relatively diverse range of fringe vegetation exists along the dam margins. Fluctuating levels may encourage the re-establishment of new fringe vegetation, including grass species such as *Cynodon dactylon*. This could have the contrasting effect of providing additional grazing every few years as the dam is drawn down, but at the same time expose livestock to an unusual quantity of fresh grazing causing illnesses related to poisoning and consumption. The positive impact is not sustained as blow downs may be relatively infrequent and land is soon inundated once again. Periodic blow downs will affect the market gardens if they continue to use the same type of pumping mechanism, as water will become increasingly unavailable or inaccessible during blow down events.

Irrigation potential. *Alternative 1:* Management of the dam as a semi-static reservoir creates conditions most susceptible to high evaporation losses and associated increase in salinity levels. Humans and livestock generally have a fairly high sodium tolerance level compared to plants. A sodium concentration of 1000ppm represents the maximum level of salinity suitable for crop irrigation (Day, 1995a). Excessive saline conditions as a result of a static or dead storage management strategy may lead to, and consequently limit, potential for both drip and spray irrigation. The cumulative impact of irrigation, utilising excessively saline water, will significantly affect the bearing capacity of the soil by creation of widespread brackish conditions. This impact could severely limit the vegetable production of market gardens which make use of flood and drip irrigation systems using water pumped from the dam.

Alternative 2: Buffer storage management will result in some dilution of sodium concentrations in the northern section of the dam, thereby enhancing the quality of water for irrigation use. Although this can be regarded as a positive impact associated with the buffer storage management strategy, it could imply unequal access to benefits for people living closer to, and further south, of the northern dam wall. Recent investigations by the limnology specialist revealed an exponential rise in sodium concentrations with distance from the dam wall (Roberts, 1995). This would indicate that the limited amount of Cunene water currently released into the dam results in the dilution of sodium concentrations. This effect will be considerably enhanced with an increase in the volume of Cunene water transferred directly into the Olushandja Dam before channelled into the canal and pipeline.

Alternative 3: A major benefit of blowing the dam down to 50% capacity every few years and refilling, would be to dilute the concentration of inorganic ions throughout the length and depth of the dam, thereby significantly improving the quality of water for local irrigation. As the Calueque-Olushandja canal does not have to be operational during blow down, water supply to the North-western Owambo Irrigation scheme may well be jeopardized.

5.2.1.4 Impacts of emergency drawdown to dead stock

Dead stock for the Olushandja Dam has been defined as 5% of capacity by Haussler (1995). It must be noted that drawing the dam down to dead stock should only happen in response to extreme uncontrollable or unforeseen events such as drought or a significant deterioration in relations between Namibia and Angola. Political indications are such that the conciliatory relationship between these two countries is likely to continue to improve in the future (McIntyre and Atkins, 1994). Severe droughts, on the other hand, are a persistent feature of this environment and rainfall has been particularly unreliable over the past 20 years (Quan *et al*, 1994).

At these times, which could be in the wet or dry season, the pumping operations at Calueque may be suspended for more than two months and the Olushandja Dam could dry up altogether. This is highly unlikely, given the uneven profile of the dam basin, provided the reserve supply is carefully managed. The rate of drawdown will be demand driven and therefore seasonally dependent. In the wet season, people

along the canal and pipeline network are less dependent on this supply from the Olushandja Dam. In the dry season, however, it is necessary to utilise the full capacity of the pipeline and canals.

Drawdown to dead stock is consequently an extreme scenario for the Olushandja Dam. Nevertheless, if this was not a realistic possibility there would be no plausible justification for the existence of the Olushandja Dam. Only the relevant categories of social impacts will be discussed including health and well being, water quality and accessibility, fishing activities and silvipastoral farming. The draw down to dead stock scenario is not likely to significantly affect social organisation or housing and settlement.

Health and well being

Spread of parasitic disease. Draw down of the dam to below 50 % capacity and further, will expose those aquatic plants colonised by secondary host organisms for urinary bilharzia. Since these species cannot withstand long dry periods, they may not survive. However, *Ludwigia stolonifera,* an important floral habitat for *B. globosus* and *L. natalensis* snails, is well adapted to changing water levels and will soon colonise new margins (Burke, 1995), especially if the rate of drawdown is slow or interrupted and the dam remains static at a low capacity. This will also encourage the breeding of mosquitoes.

Gastro-intestinal illness. The presence of *E. Coli* detected in water samples collected by the limnology specialist are indicators of pollution, particularly human and animal faecal matter (Etellin, 1995). Consumption of bactriologically contaminated water causes diahorrea, and a positive feed-back cycle is created as *E. Coli* parasites are continually being excreted and consumed. Drawdown of the dam will not reduce pollution levels in areas where the dam is extensively utilised by people and cattle. Pollutants may be concentrated as the same number of people and cattle remain dependent on less water in the dam. Gastro-intestinal disease may thus be exacerbated.

Fishing activities

Size of catches and fish production. Drawdown will lead to an increase in the average number of fish per unit volume of water. Catch sizes will thus increase significantly as the level of the dam drops. Although fish production may decrease, the number of fish will not be reduced unless the dam reaches very low capacity. In this event a decrease in amount of free oxygen will detrimentally affect fish stock.

A degree of free oxygen is essential for all forms of aquatic life. A limited range of oxygen levels measured by Roberts (1995) indicate that the dam is presently well mixed. However, with an increase in area to volume ratio on draw down, a raised chemical oxygen demand can be assumed as chemical concentrations increase (COD) (Day, 1995a). Biological oxygen demand (BAD) is increased as floating mat plant assemblages, sedges and floating-leaved vegetation (Burke, 1995) colonise a smaller expanse of water. This concentration of floating aquatic vegetation will limit atmospheric oxygen transfer. The effect is a significant increase in total oxygen demand (TOD) and a corresponding decrease in the availability of free oxygen to the detriment of all aquatic life.

In the event of draw down to dead stock there may be a negative impact on fishing activities on a fairly long term basis. It will take several months for fish stock to increase to an equilibrium on refilling of the dam, particularly if the intensity of fishing activity remains unchanged.

Water quality and accessibility

Reduced accessibility. As the dam is lowered, water will become increasingly less accessible for collection, washing, bathing and irrigation purposes. Some households will be more detrimentally affected than others depending on the nature of the profile of the dam basin in relation to settlements i.e: shallower areas on flat gradients will be the first to dry up. Communities near the north wall may not be affected to the same extent as communities further south along the dam margins.

Increased turbidity levels and eutrophication. Reduction in the areal extent and depth of the dam on drawdown is unlikely to have a significant affect on turbidity levels until the level is well below 50% capacity and the effects of fishing, bathing an washing activities become more marked. Suspensoids, including silt and algae will eventually become concentrated as the volume of water decreases and the same number of cattle and people remain dependent on the dam. Eutrophication associated with decaying plant material and increased concentrations of detritus is also likely to occur.

Increased salinity levels. Drawdown will not have a concentration effect on sodium content of the dam. The profile of the dam basin is such that the area to volume ratio will decrease slightly with a corresponding decrease in evaporation loss. Salinity levels are thus unlikely to change.

Silvipastoral farming

Inundation of *mahangu* fields and communal resources. There is a small chance of cultivated areas around houses and market garden structures being extended towards dam margins as the water level drops. These may become inundated when the dam is refilled to capacity.

As with the blow downs associated with the third alternative interim management strategy, newly exposed communal areas may become colonised by grass, creepers and succulents comprising fringe vegetation. The contrasting impact associated with grazing renewal as discussed above may occur, especially in wet season conditions.

Irrigation potential. Although salinity levels will not increase, emergency drawdowns will have a significant effect on any small-scale local irrigation schemes that might be encouraged by the initial filling of the dam to capacity. The water supply for such initiatives will become unreliable as the level of the dam is lowered. Impact will be most severe in the dry season. Similarly, water will no longer be available for pumping at the market gardens, unless channels between the gardens and the dam are extended and maintained at a rate corresponding to the decreasing water level.

Drawdown will be necessitated by a suspended supply from Calueque. Consequently, water transfer to the North-western Irrigation Scheme will also be similarly affected.

5.2.2 Secondary impacts

The interdependent relationship between biophysical and social environmental effects, particularly with regard to health and agriculture, makes it difficult to distinguish between primary and secondary impacts. Strictly speaking, health impacts are directly related to the increased breeding area for secondary host organisms, and consequently once removed from a direct relationship to dam construction. And yet, it does not seem feasible not to regard this as a primary impact. Classification into primary and secondary should not be a reflection of significance. For the purposes of the study, secondary impacts will include existing and induced psychological perceptions of water supply and the upgrading scheme. Secondary impacts will thus be relevant to dam construction and vary only slightly in light of the three alternative management strategies.

An attempt was made during the household interviews to establish people's perceptions of the influence of the dam and its associated benefits and disadvantages. It became apparent that psychological attitudes of many individuals are governed intrinsically by cultural practices and traditions as well as by extrinsic political factors.

The *oshana* system in northern-central Owambo is the most important natural phenomenon in Namibia from both a biophysical and social perspective. All natural resources in the area are dependent on the ephemeral flow of the *oshanas* and the occasional extensive flood events or *efundjas*. The subsistence survival of rural social groups and communities are in turn directly dependent on these natural resources. In addition to being a unique ecological system, the *oshanas* are thus the foundation on which people base their livelihoods, lifestyles and social organisation. The replacement of one of the most active *oshanas* in the Cuvelai (the Oshana Etaka) with the Olushandja Dam will inevitably have psychosocial consequences. These impacts are very difficult to identify and evaluate on the basis of responses to questions about the dam, particularly as the research team were outsiders and dam construction was completed so many years ago.

Although people were aware of negative impacts associated with the dam such as those related to health and loss of grazing, the overriding attitude was one of complacency and appreciation. Respondents were generally happy or satisfied that the dam had been built. Most were of the opinion that the dam belonged to the government but was built to benefit the people, both locally and regionally. It was clear that increased exposure to technological and infrastructural developments has raised people's expectations of what their living standards should be - they are grateful for the dam, but a second pipeline with potable water would be preferred. Although, the dam was no doubt initially regarded with wariness and suspicion, the homogeneity of political affiliations among the Owambos causes people to associate government actions with favourable intentions and consequences.

Responses during the household interviews revealed the importance of the dam as an accepted reference and focal point in community interaction and activities. This can be attributed to the consistency of the dam's presence in an environment characterised by marked fluctuations and seasonal variabilities in climate, which, in turn, has a significant affect on all aspects of people's lifestyles and survival ability. The permanence of the dam is also what links it to other government infrastructure and services.

Raising of the level of the dam only likely to induce psychosocial stress among those families and market garden workers that have to relocate as a result of the inundation of their homes and land. This stress is likely to take the form of reluctance due to inconvenience and worry about the affect of relocation on access to resources, as opposed to anger directed at the government. Any of the alternative dam management strategies is likely to be accepted by the people, unless the government takes a drastic action which seriously undermines the trust of the communities. With regard to the possible drawdown of the dam to dead stock, people are likely to recognise and appreciate the necessity of this action in terms of regional benefits. However, some psychological impact is inevitable, even among those who will not be directly affected by such changes as the dam has considerable local existence value.

5.2.3 Regional impacts

The construction of the Olushandja Dam in the early 1970's was part of an envisaged plan to ensure a reliable water supply to fulfill the escalating demand from the relatively densely populated Cuvelai basin. It is consequently a component of a regional bulk water supply project based on the idea that water is a major enabling factor for development in Owambo. A number of positive and negative effects are associated with the development of the water supply network comprising the canals, pipeline and purification works. These include impacts of varying significance, magnitude and geographical extent on population distribution, crop production, transhumance and infrastructural development. In many cases the provision of secure water throughout the year has significantly affected people's lifestyles and cultural practices. A detailed investigation of these regional implications is beyond the scope of the present study, but a comprehensive discussion is provided a number of NGO studies and government reports and in particular, a study by the Environmental Evaluation Associates of Namibia undertaken in 1992.

The pipelines and canals of bulk water supply network are fed direcly with water from the Cunene river, via the site of the Olushandja Dam. If this supply is ever jeopardized, thousands of people throughout the Cuvelai, will be directly dependent on the reserve supply in the dam. The primary objective of impounding water on the Namibian side of the border is to guarantee surety of regional supply. Maximum regional benefit of the upgrading of the Olushandja Dam is therefore guaranteed on the basis of two assumptions. Firstly, that the positive consequences of the provision of a permanent water supply outweighs the numerous negative impacts of the bulk water distribution scheme. Secondly, that the supply from Calueque is not curtailed for a period of two months. In this event a secondary reserve scheme, such as that from Ruacana implemented during the war, would have to come into effect.

The interim management strategy of the Olushandja Dam reservoir supply will have some affect the quality of water fed into the distribution network.

If the dam is managed as a static reservoir (Alternative 1), water in the Olushandja-Ogongo canal will come from the Calueque-Olushandja canal i.e.: directly from the Cunene River. Water quality in the canal will reflect the quality of the Cunene and thus be subject to short term seasonal variations or long term trends depending on climatic conditions. Cunene water is often silt laden, but has a low sodium content (Roberts, 1995).

If the dam is used for buffer storage (Alternative 2), water will be consistently pumped directly from the dam. Initially, the supply may contain a higher concentration of non-volatiles and suspended material but continuous mixing in the dam will soon marginalise any significant discrepancy between the quality of water in the dam and feeder canal from Calueque.

If the blow down management strategy (Alternative 3) is identified as the preferred option, water will be fed directly from the Cunene via the underwater syphon, as with alternative 1. This operating system will change once every few years, depending on the chemical concentration levels in the dam and water will be pumped directly from the dam till a drawdown level corresponding to approximately 50% capacity is reached. The quality of water in the canal will consequently be considerably reduced for a period of several months once every 4 or 5 years. Drawdown events can be confined to wet seasons when alternative supplies of water are available to the communities along the canal.

Piped water is purified and will consequently not be affected by choice of dam management strategy. Water in the Etaka canal is gravity fed from the dam and the quality of this supply is only likely to be affected by the blow down approach. This strategy is likely to lead to a long term improvement in the overall quality on dam water and will consequently have a cumulative positive effect on water quality in the Etaka canal.

5.3 Impact Evaluation

An evaluation of the identified impacts should reflect a balance between achieving the aims of the proponent and minimising negative consequences for the social environment. According to Finsterbusch (1985), evaluation is the SIA step that judges the value of both positive and negative impacts. Assigning value or significance to a particular impact is generally recognised as a problematic component of impact assessment (Fuggle and Rabie, 1992). This step inevitably takes the form of a subjective judgement ultimately based on the values of the evaluator (Finsterbusch, 1985). These could well reveal a bias towards either directly affected social groups, regional beneficiaries or the project proponents. In the end, SIA can determine change and promote sustainable development only if the final recommendations present decisionmakers with practical and realistic solutions to mitigate undesirable social impacts. Elaborate schemes at aimed social upliftment that are not directly related to the project are unlikely to be

seriously considered by government authorities in developing countries, subject to financial, political and bureaucratic constraints. These considerations form the basis of the assessment approach adopted in the study.

In developing countries, which may have limited financial and technical resources, it is essential that mitigatory efforts be focused on those impacts that do indeed have significant social consequences (Fuggle, 1991). It is necessary to exempt project actions that are unlikely to have far reaching environmental implications, or in the case of the current study, that are unlikely to induce further impact beyond those associated with dam construction. The decision as to which impacts to focus on is once again subject to personal judgement on behalf of the assessors. There are no objective measures which can be used to determine why one impact should be regarded as more important or more significant than another (Fuggle and Rabie, 1992).

In an SIA based on a political or qualitative approach to data collection and analysis, significance should be determined by the reactions of the affected public to the foreseen consequences of the development project. Although the present study achieved a fairly high level of community participation, identification of the most significant impacts remains subject to the discretion of the assessor, since the nature of the project did not allow for full disclosure of information to the affected public. Nevertheless, the study team felt confident that the main social concerns were identified during the course of discussions and PRA activities in the field. It is assumed that the subjective judgements concerning the nature and degree of impacts that follow are based on an adequate amount of information concerning the values and priorities of the affected communities.

The framework technique used in the evaluation considerably oversimplifies the nature of the impacts in the development context characterised by the study. This approach fails to demonstrate important linkages between the various impacts and how they may be spatially and temporally related. It is merely a record of the author's judgement on a range of issues relevant to the social environmental implication of the project. The framework should therefore be regarded as a communication tool, as opposed to an objective decisionmaking tool. When dealing with a complex set of interrelated social and biophysical impacts, characteristic of rural communities in developing economies, it is seldom possible consider all variables and relationships in a single framework or matrix. Recommendations are best arrived at through consideration of a combination of factors which may not be clearly illustrated by summary matrices.

In the case of the upgrading of the Olushandja Dam, a simple framework is used to summarise which project actions will impact on the various facets of rural life. Both the evaluative and predictive components of the project are considered. Only with regard to management alternatives can the summary be used to aid judgement and form a basis for a final recommendation. Impacts associated with dam construction are considered in their capacity to aid the identification of future impacts of the upgrading scheme. Inevitable impacts associated with raising the level of the dam to full capacity and possible drawdown to dead stock are evaluated for the purpose of identifying areas for mitigation.

Since the selection of a suitable management strategy involves numerous types of impacts, no one alternative emerges as the obvious best choice. A system of subjective weighting of impacts as high, medium or low is thus used to aid the evaluation. These judgements are in fact an estimation of how affected social groups and individuals will respond in terms of attitude and action. Social responses to environmental change can seldom be as accurately predicted as biophysical changes, making it all the more important to acknowledge the subjectivity inherent in a social analysis. Numeric ranking and quantification associated with objectivity were thus avoided as there are fundamental limitations of this approach in developing contexts, as discussed in chapter 3.

Criteria and definitions used for the identification of significant impacts requiring mitigation are a combination those recommended by the Interorganisational Committee guidelines for SIA (1994) and Canter and Canty (1993). These include:

- the probability of the event occurring
- the magnitude in terms of amount of people affected
- the degree to which the impact can be mitigated against
- likelihood of causing subsequent impacts
- level of uncertainty over possible effects
- the relevance to present and future policy decisions (i.e.: the degree to which a precedent is established for future actions or represents a decision in principle about a future consideration.)
- the degree of controversy over the issue

Table 3 identifies the association between dam operation and either positive (✔) or negative (✘) impact on the surrounding social environment.

Impact category	Primary Impacts	Evaluative: Reservoir Construction	Inevitability: Rise to Full Capacity	Management Alternatives			Inevitability: Drawdown to dead stock
				1	2	3	
Health and well-being	Spread of parasitic disease	✘	✘	✘	✔	✔	✔
	Gastro-intestinal illness	✘	✘	✘	✔	✔	✘
Fishing activities	Fish production	✔	✔	✘	✔	✔	✘
	Size of fish catches	✔	✔	✔	✔	✔	✔
Water quality and access	Water access/availability	✔	✔	✔	✔	✘	✘
	Turbidity levels	n/a	✘	✘	✘	✘	✘
	Salinity levels	n/a	✘	✘	✔	✔	no impact
Settlement and housing	Induced settlement	no impact	no impact	no impact			no impact
	Household inundation	✘	✘	no further impact			no further impact
	Market garden inundation	n/a	✘	no further impact		✘	✘
Patterns of social organisation and movement	Social organisation and human movement	✘	✘	no further impact			✔
	Transhumance	✘	✘	no further impact		✔	✔
	Psychosocial stress	✘	✘	no further impact		✘	✘
Silvi- pastoral farming	Inundation of *mahangu* fields	✘	✘	no further impact			no further impact
	Inundation of communal resources	✘	✘	no further impact		✔	no further impact
	Grazing	✘	✘	no further impact		✔	✔
	Irrigation potential		✘	✘	✔	✔	✘

Table 3: Negative (✘) and positive (✔) impacts associated with the need to store or extract water.

For the purposes of the evaluation it is considered adequate to consider the above in terms of High (H), Medium (M) and Low (L). The tables below summarises the relevant information in frameworks A, B ,C, D and E in Appendix 3.

Impact category	Primary Impacts	Evaluative: Reservoir Construction	Inevitability: Rise to Capacity	Management Alternatives			Inevitability: Drawdown to dead stock
				1	2	3	
Health and well-being	Spread of parasitic disease	- H	- H	- H	+M	+H	+M
	Gastro-intestinal illness	- H	- H	- H	+M	+M	+M
Fishing activities	Fish production	+ H	+ M	- L	+M	+M	- H
	Size of fish catches	+ H	+ L	- L	+M	+H	+ H
Water quality and access	Water access /availability	+H	+ M	-	-	- M	- H
	Turbidity levels	n/a	- L	- L	+L	+M	- H
	Salinity levels	n/a	- H	- H	+M	+M	no impact
Settlement and housing	Induced settlement	+/- L	+ L	+ L			no impact
	Household inundation	- M	- H	no further impact			no further impact
	Market garden	N/A	- H	no further impact		- M	- H
Patterns of social organisation and movement	Social organisation and human movement	- H	no further impact	no further impact		+ L	+ L
	Transhumance	- M	no further impact	no further impact		+L	+ L
	Psychosocial impact	+ H	+ L	no further impact		- M	- H
Silvipastoral farming	Inundation of *mahangu* fields	- M	- M	no further impact			no further impact
	Inundation of communal resources	- H	- L	no further impact		+L	no further impact
	Grazing	- H	- M	no further impact		+L	+ M
	Irrigation potential	+ H	+ M	- H	+M	+M	-

Table 4: Impact summary in terms of Positive (+) and Negative (-) and High (H), Medium (M) & Low (L).

Impact Category	1: SEMI-STATIC RESERVOIR	2: BUFFER STORAGE	3: INTERMITTENT DRAWDOWN
Health and well-being	High neg. impact	Medium pos. impact	High pos. impact
Fishing activities	Medium neg. impact	Medium pos. impact	High pos. impact
Water quality and access	Medium neg. impact	High localised pos. impact	Medium neg. impact
Market gardens	High neg impact	Medium pos. impact	Medium neg. impact
Settlement and housing	No further impact	No further impact	No further impact
Social organisation and movement patterns	No further impact	No further impact	Low positive impact
Psychosocial effects	No further impact	No further impact	Medium negative impact
Silvipastoral farming and irrigation potential	High neg. impact	High localised pos. impact	Medium positive impact

Table 5: Summary of impact relating to the three alternative management strategies

From the above it can be seen that negative impacts are associated with the semi-static management alternative. Standing water inevitably leads the spread of illness and disease and encourages the build-up of sodium concentrations. With a limited amount of water being pumped into and out of the dam at the south wall 19km away from the inlet, there is a significant possibility that such impact will detrimentally affect the surrounding communities. None of the alternatives are free of some negative influence, even in the buffer storage approach, positive impacts are undermined by their limited geographic extent. This is also likely to be the most expensive option in terms of pumping costs and some infrastructural changes such as a facility to pump directly from the dam to the purification works. It is, however, beyond the consultant's brief to consider such financial implications.

A number of negative impacts associated with raising the dam to full capacity and semi-static storage are clearly mitigated by the implementation of either of the alternative management strategies. The following discussion of mitigatory options is generally applicable rather than focused on conditions relating to a single water management strategy.

6 MITIGATION OPTIONS AND MONITORING

Mitigation measures as part of environmental assessments are designed reduce negative impacts within reasonable environmental and economic constraints (Canter and Canty, 1993). In the course of an social assessment attention is also given to optimising beneficial development opportunities (HSRC, 1993). This aspect of mitigation is particularly relevant to SIA in developing southern African countries which are as rich in cultural heritage as in natural flora and fauna. Mitigation aimed at benefitting local communities is also in keeping with the pro-development approach to EIA characterised by the IEM procedure.

A further consideration, particularly in rural development contexts, is that the range of technologies used in mitigation is well-matched to the skills and needs of the local people as this will influence maintenance and operational requirements (Fuggle, 1991). The importance of this aspect has already been demonstrated with regard to other infrastructural components of the bulk water distribution network in Owambo. Government designed and constructed take-off points along pipelines are poorly maintained. This can be partly attributed to the lack of a conservation ethic engendered by the idea that the government is responsible for water provision and infrastructural maintenance, and by the fact that the supply system used is not on a technological par with the abilities and understanding of local people. Particular care must be taken in this regard with the realisation of irrigation potential around the Olushandja Dam. Sustained soil productivity over the years can be largely attributed to the nature of traditional agricultural practices. These should not be undermined by the introduction of inappropriate technological innovations.

The U.S. Council on Environmental Quality's (1987) definition of mitigation is threefold:

- avoiding impact altogether by not taking a certain action or parts of an action.
- minimizing, rectifying or reducing the impact through the design or operation of the project or policy.
- compensating for the impact by providing substitute facilities, resources or opportunities. (40 CFR 1508.20)

Interorganisational Committee (1994)

In accordance with IEM principles, mitigation measures for Olushandja Dam should focus on the second two options. This is also necessitated by the fact that the infrastructural requirements for upgrading are already in place. HSRC (1993) suggest that there has been a shift in emphasis regarding mitigation in the light of current development trends. The mitigation of adverse impacts can no longer be considered as sufficient in itself. Accordingly, development projects should be used to make a break with past planning approaches whereby socio-economic costs of infrastructural development have been borne by marginalised communities. Development should rather promote more equitable access to resources and challenge the structural relationships that perpetuate the status quo (Watermeyer *et al*, 1991 in HSRC, 1993). This is particularly pertinent to parts of southern Africa subject to deliberate underdevelopment in political history. In these areas the objectives of a development project should be broadly defined so as to include mitigatory input beyond the provision of the planned facility or construction scheme.

According to the Interorganisational Committee (1994), ideally, mitigation measures should be built into the selected alternative. Mitigation is thereby directed at the proposed development rather than being

suggestions aimed at helping the communities cope with changes that are regarded as inevitable. Freudenberg (1986) emphasises the role of SIA practitioners in helping developers learn how to do a better job of adapting the project to the people rather than *vice versa*.

Incorporating social consideration into the operation strategy for the development project has been the primary objective in the proposal of alternative management plans for Olushandja Dam. The approach also allows for the integration of social and environmental concerns with the planning and development process, a notion central to the IEM policy. It is, nevertheless, appropriate to identify additional mitigation measures that could be adopted with time or may be the responsibility of another government authority or unit. These measures are aimed at minimising or compensating for adverse impacts that cannot be avoided. The Interorganisational Committee for the Guidelines to SIA refer to three benefits of identifying such unresolvable social impacts that may result from a proposed project. The first is identifying methods of compensating individuals and the community. The second is that the community may identify ways of enhancing other quality-of-life variables as compensation for adverse effects. Finally, identification or unresolvable impacts makes community leaders and representatives for the project proponents more sensitive to the attitudes and perceptions of the community at large.

The following discussion of mitigatory measures acknowledges these benefits as far as possible. Included in the discussion of mitigation, are suggestions aimed at maximising local benefits and opportunities that arise as a consequence of the upgrading scheme. Suggestions are confined to measures that are cost-effective and can be considered realistic and feasible on a relatively short term basis, considering the dynamic nature of effective processes such as urbanisation

6.1 Recommended mitigatory measures

6.1.1 Health and well-being

The spread of parasitic disease and occurrence of gastro-intestinal illness is regarded as a highly negative impact associated with the presence of the Olushandja Dam. This permanent body of water provides a habitat for the secondary host organisms of bilharzia and malaria and is in parts subject to bacteriological contamination to the detriment of surrounding communities. Whereas parasitic disease, particularly malaria can have fairly widespread effects in the study area, gastro-intestinal illness is locally confined to those who are directly dependent on the dam as a source of drinking water in the dry season. None of the alternative management strategies can guarantee the elimination of these sicknesses, but the negative impact can be more easily mitigated through the implementation of *alternative 2* or *3* as opposed to semi-static reservoir management.

Extensive bacteriological contamination of parts of the dam can be reduced by the consistent partial renewal of water which has the effect of diluting the *E. coli* parasite and mitigating against the build up of pollution levels. These positive effects will be largely confined to the northern section of the dam under buffer storage conditions. Intermittent drawdown of the dam, every few years, should successfully mitigate against the cumulative build up of pollution and subsequent contamination.

It is imperative that the implementation of an appropriate dam management strategy is complemented by an extension program aimed at heightening people's understanding of the detrimental effects of water pollution particularly in the form of human and livestock faecal matter. The possible introduction of

sanitary facilities in the form of VIP latrines should be investigated for those residents who have direct contact with the dam on a daily basis. Such investigation should be undertaken in conjunction with DAPP, FINNIDA and UNICEF as these NGOs have undertaken research on sanitation and the provision of appropriate facilities in other parts of Owambo (Dahne, 1995; FINNIDA, 1994; Jones, 1994). Implications for groundwater quality should be investigated prior to the introduction of such sanitary facilities.

People should be encouraged in the use of simple, inexpensive filtering devices for their drinking water, using sand or ash. Such techniques are less resource-use intensive compared to boiling of water which requires considerably more time and fuel. The concept of filtering should not be an unfamiliar one since filtering devices are used in the brewing of *mahangu* beer.

A number of measures have been recommended by Curtis (1995) to mitigate against the spread of snails and associated human and livestock disease. The occurrence of snails is largely confined to the northern end of the dam. Little can be done to prevent an increase in the number of suitable habitats for plants and snails associated with the inundation of a larger area as the volume of water in the dam is increased. The application of molluscicides has been suggested as an efficient means of controlling snail numbers (Curtis, 1995). However, the effects of such poisons are not confined to parasite hosting organisms and plants and may have a detrimental affect on other aquatic life plants and fish. These and the use of other chemical treatments, including copper sulphate and bayluside, are also costly and efforts should initially be focused on less sophisticated techniques.

Provided the rate transfer of snail species from the Cunene is not significantly increased by a direct link with the Cunene supply, buffer storage (*alternative 2*) ought to have a mitigating effect on the spread of snails since their ability to survive decreases proportionally with an increase in water velocity. Although the currents created by continuous pumping and replacement are unlikely to be sufficient to eliminate the problem, the northern section will become a less favourable habitat for snail which prefer standing backwaters. The use of appropriate screens or filters at the uptake point may also be a feasible option as local fishermen are not dependent on those fish species transferred from the Cunene River.

The implementation of *alternative 3*, entailing intermittent fluctuations of the level of the dam on a relatively large scale, would affect the survival *Ludwigia stolonifera* and other plant species host to bilharzia carrying snails. Although *Ludwigia stolonifera* is capable of drifting to an extent, it has to be rooted to the bottom of the dam (Curtis, 1995). The chief advantage of lowering the dam level would be to facilitate the removal and collection of vegetation. Suitable programs could be designed to integrate community members in plant operation removals every few years. If drawdown were to take place at the appropriate time of year, aquatic plant accumulations would act as nutrient rich mulches for *mahangu* fields, improving agricultural yields. The benefits of removing these plants is thus enhanced. Such removal programs would have to be subject to careful control so as to avoid detrimental ecological effects of eliminating too much vegetation, necessary for the maintenance of fish production. As with the occurrence of gastro-intestinal illness, education programs dealing with the dangers of raw water consumption should accompany the implementation of mitigation measures aimed at reducing snail numbers. Ideally, additional sources of treated water should be provided, particularly on the east side of the dam, to minimise human and animal contact with the dam.

In a developing context, characterised by the area around the Olushandja Dam, the susceptibility of the general environment to further impoverishment is closely related to a reduction in human health and living standards. The health issue should thus be holistically addressed in conjunction with programs to promote the sustainable use of communal resources. It is recommended that a health awareness program be launched in conjunction with the numerous NGOs operating from Oshakati, specifically aimed at those people dependent on raw water from the dam and open canals in the dry season and during times of drought. Mitigation aimed at improving health and well being in the vicinity of Olushandja Dam ought to be the joint responsibility of the Department of Water Affairs and the Directorate of Veterinary Services in the Ministry of Agriculture, Water Affairs and Rural Development and a relevant department or directorate in the Ministry of Health and Social Services.

6.1.2 Fishing Activities

There are few negative impacts on fishing activities directly associated with the upgrading scheme. Fishing in the dam and control of this activity is, nevertheless, a controversial subject in the study area. This was demonstrated by a heated debate between fishermen in the Epalela township. The exact nature of the control measures of fishing activities already implemented, supposedly by the Department of Nature Conservation, could not be determined. This was due to an inability on behalf of the study team to make contact with the relevant Nature Conservation Authorities. It was, however, evident from the response of fishermen and household heads, that these measures had been implemented with little regard for the needs and requirements of local communities, and characterised by inadequate explanations and justification on behalf of the implementing agents.

Much of this confusion can be blamed on the absence of an official standpoint regarding fishing activities on inland water bodies. The White Paper on fishing, currently in preparation, should act as a basis for the re-formulation of control mechanisms on fishing activities for the Olushandja Dam. The fishing community based at the Epalela township have shown themselves to be an easily mobilised group of individuals who are not entirely opposed to the idea of control measures to ensure sustainable exploitation of the fish reserves in the Olushandja Dam. Suggestions were forthcoming from these local fishermen concerning the formation of a representative group to liaise between the relevant authorities, the headmen and the fishing community.

It is recommended that the formation of such a committee is encouraged and facilitated. The duties of the committee ought to extend beyond the implementation of appropriate measures to limit size of catches at certain times of year. The group should act as middlemen between community members involved in fishing activities and those individuals who hold the monopoly on the sale of nets, line and hooks. Such equipment should be made available at reasonable prices to a broader sector of the community once adequate control mechanisms are in place to prevent over-exploitation. It would be preferable to encourage local entrepreneurship and competition to act as a system of price control, as opposed to government intervention.

In the event of the adoption of the *alternative 3* as a management strategy, particular attention would have to be paid to limiting the size of catches at times of drawdown of the dam to 50% of capacity. At these times, fish populations will be vulnerable to over-exploitation. A general exploitation rate for fish in the Olushandja Dam could not be identified by Hay and Van Zyl (1995), authors of the specialist report on fish, and further studies are recommended before specific limits on fishing activities are imposed. It is

likely that the use of drag nets made out of mosquito mesh will have to be discouraged so as not to extract too many undersize fish form the dam. A number of respondents also attributed high turbidity levels of the dam to the use of drag nets by the fishermen.

In the past small earth dams have been excavated alongside the main Olushandja Dam in an attempt to maximise positive benefits of the dam. It was though that these dams could be artificially stocked and a small local fishing industry established such as that described in a case study from Indonesia (Soemarwoto, 1991). The scheme failed largely due to the use of imported labour and lack of local community involvement in the project (Ingram, 1995). The reinstatement of such initiatives is not recommended as standing ponds of water are likely to encourage the spread of disease. Efforts to encourage exploitation of the fish reserve should be focused on existing fishing enterprises and fishing community at Epalela. It may also be useful for sewing clubs such as that at the Elao market garden to be encouraged to modify or make fishing nets of a suitable mesh size.

6.1.3 Water quality and accessibility

Raising of the level of the dam may make this supply of water more accessible to an increased number of households. Turbidity levels in the dam can only be reduced by improving the area to volume ratio. Filling of the dam to capacity will considerably extend the shallow margins of the dam where fishing, bathing and collection activities are take place. The presence of livestock drinking and wading in the water effectively disturb the silty substrate of the dam. There are few mitigatory options against high turbidity levels. People can once again be educated as to the relatively innocuous effects of high turbidity provided the water is not contaminated. Respondents during household interviews seemed to associate disease with the "dirty" appearance of the water. High turbidity levels consequently have a psychological as well as physical impact on health and well-being. Individuals responsible for water collection should be encouraged to collect from the surface layer and preferably let the water stand for some time before it is used for cooking or consumption.

High salinity levels can be effectively mitigated by implementing a strategy other the first alternative of semi-static reservoir management. The effect of increasing sodium concentrations are likely to be cumulative. It may take several years before salinity levels exceed the recommended standards for drinking water. Increasing sodium levels down the length of the dam, nevertheless, testify to the significance and inevitability of this problem. Buffer storage should reduce salinity levels through dilution effects in the northern section of the dam. Dilution can be achieved throughout the dam through intermittent drawdowns which should effectively mitigate against the cumulative build up of sodium. The use of sand or ash filtering devices by household occupants will also significantly improve the quality of drinking water. Water purifying tablets could also be made available to people living adjacent to the dam, although this may not be the most cost-effective solution.

6.1.4 Inundation and housing

Bisset (1984) identifies relocation as the most important of all social impacts associated with dams. It has been calculated from aerial photographs flown in May 1995 that 30 households will have to be relocated as a consequence of raising the level of the Olushandja dam to 1 106m a.m.s.l., 15 on the west side of the dam and 15 on the east side. A further 41 households between contours 1 106 and 1 107.5m a.m.s.l. will have to be given the option of relocation. The acquisition of compensatory land in a communal area

represents an important challenge for the government which is likely to set precedents for future projects in communal areas. Although some compensation measures should have been associated with the construction of the canals and pipelines comprising the bulk water supply scheme, there are no records of any legal disputes that might have accompanied the expropriation of land (Werner, 1995).

In effect the government is entitled to lay claim to the land directly adjacent to a centrally administered water body by declaring the land a dam basin control area in terms of the Water Act. Despite such legislation, expropriation of land without compensation under the current post-election political climate is not advisable and is likely to generate dissatisfaction amongst communities in the study area. There is existing potential for conflict in the roles of traditional authorities versus those of the newly appointed political councillors. Matters regarding the distribution of land should consequently be delicately handled. As yet the government has no official policies regarding land compensation and official responsibility for the resettlement of people in rural communal areas falls to the Ministry of Lands, Resettlement and Rehabilitation. Removals necessitated by the upgrading of the Olushandja Dam should be jointly administrated by this ministry in conjunction with the DWA.

The acquisition of compensatory land would have to be negotiated with the senior headman, Daniel Showe. The process should be transparent to both the affected public and the relevant political authority (Johnny Ipinge - elected councillor for the Omusati region). In most cases it may be possible for households to relocate their *epyas* and *egumbos* within a few hundred metres of their original place of residence. The government should accept responsibility for payment of the lease to the headmen should he demand such payment. It may be possible to negotiate a different type of arrangement with the headman as there is no official recognition of the right of traditional authorities to accept money for land (Werner, 1995). In the past land usufruct was acquired through payment in cattle, grain or hoes to the king or headman. It was only through the introduction of a cash economy brought by external contact, trade, Christianity and colonialism, that traditional authorities were paid for land in monetary terms (Williams, 1991). The system is, nevertheless acknowledged by the government and must therefore be respected.

Owing to the complexities associated with the resettlement and compensation issue in communal areas, this aspect of mitigation should be made the subject of a specific relocation study or report, to be undertaken by a suitably objective and expert organisation such as the Social Sciences Division of the University of Namibia. Such a study could well form the basis of much needed official government policy regarding compensation for expropriated land in communal areas. In the interim, several suggestions can be made based on previous experience with the relocation of rural communities in developing countries.

Resettlement areas should be located as near as possible to the original communities so that people involved are not subject to entirely different social and ambient conditions (ICOLD, 1992). An attempt must be made to ensure that relocated households are afforded the same, if not better, opportunities for self-improvement in their new place of residence (ICOLD, 1992). People should not be deprived of the means to practise activities such as fishing or irrigation. For this reason compensatory land should preferably not be located more than a few minutes walk further away from the dam, unless people express a desire to be closer to other resources such as potable water provided by the pipeline. After resettlement some change in social networks and relationships can be expected. This should be catered for through suitable social provision planning by ensuring access to schools and clinics for resettled families. Although present day Owambo communities are thought to be relatively politically and culturally

homogenous (Tapscott, pers. comm., 1995), attention must nevertheless be paid to traditional kinship and possible social distinctions which could lead to conflict between households. For example, during interviews in the study area it was apparent that some community members were very disapproving of Angolan refugees utilising Namibian resources.

It was also evident from discussion with household members that people formed strong ties with neighbours and family. As a result, significant psychological effects could result from relocation. Previous experience has shown that fear of the unknown, of a change from established relations with both the environment and friends, can have serious consequences even resulting in a increase in illness (Bisset, 1984). This psychological impact is lessened by the nature of communal settlement whereby resource use and land occupation in an area by newcomers does not seem to be begrudged by those already resident on adjacent land. Adequate warning must nevertheless be given by authorities to all members of the affected social group as well as those that may be subject to resettlement, as increased pressure on communal resource resulting from relocation concerns the community at large.

Examples of relocation programs in developing countries quoted by Freudenburg (1986) illustrate that the younger and more affluent members of society fare better in the relocation process than older, poorer or less well educated people. The physical relocation of the traditionally built Owambo household is likely to be a labour intensive process utilising the same structural materials. Female headed households, comprising mainly female occupants or elderly members, may require assistance in this regard. It is recommended that a small government sponsored labour force, comprising local individuals, be made available to assist household heads in the moving and rebuilding of housing and fencing structures. Household members should be involved as far as protection of private possessions and belongings are concerned, as well as to determine layout and any desired structural changes to the *egumbo*. As land is not traditionally inheritable property, only the requirements of the current leaseholders need be considered by government authorities in the relocation process.

6.1.5 Patterns of community organisation and movement

A disruption of movement patterns is regarded as a highly negative impact caused by the presence of the Olushandja Dam, and one which will be compounded by the raising of the level of water to capacity. Management of the dam at full supply will hold potential for further negative impact in this regard as there will be no flood attenuation. Overflow is likely during periods of the *efundja* and high rainfall, even in the absence of a natural catchment area for the dam. The north and south walls of the dam may consequently be impassable to people and livestock. Buffer storage would alleviate dependence on the daily supply from Calueque and would allow for some flood attenuation in the Olushandja Dam. The impact nevertheless remains a difficult one to mitigate without significant construction operations.

The fact that people on the east side of the dam were isolated from clinics, churches and other infrastructure, as well as friends and family on the west bank, was expressed as a contentious issue amongst community members during household discussions and the group workshop session. There was generally popular demand for a bridge to be built across the dam. A number of sites were identified for this bridge on the community generated maps. The most commonly identified suitable site was where the old Ooshala road used to cross the Oshana Etaka in the dry season approximately two thirds of the distance towards the south wall and directly opposite the Elao market garden. This is a relatively narrow point in the dam, historically used for communication between the east and west banks of the *oshana*.

According to members of the community, it will be sufficient if the bridge allowed for access on foot and livestock and does not necessarily have to cater for vehicular traffic.

Other options could also be considered such as a ferry or regular form of public transport around either end of the dam. People are, however, concerned that they can still get across the dam at night, particularly in emergency situations when children fall ill and the Ooshala clinic is closed. An important factor about the bridge is that the community identified a solution to the problem. People will consequently be eager to see that their proposition becomes a reality. The construction of a bridge is likely to significantly improve popular opinion of the Department of Water Affairs and any other government authority that may be involved. Local labour ought to be readily available in the study area and the construction project will be enthusiastically supported by the local communities who should be fully informed of the government's intentions. it is recommended that the engineering and economic feasibility study be undertaken for the construction of a simple foot-bridge above the level of full supply. A concrete structure should be designed with sufficient culverts so as not to impede water exchange on either side of the bridge. The feasibility of drawing the dam down almost to dead stock for the construction period should also be subject to investigation.

Bridge construction will hold numerous positive benefits for the community in both a physical and psychological sense. Community mobility will be enhanced and business ventures in the towns of Onesi, Epalela and Eunda will receive further support. Sales of fish and vegetables from the market gardens will also improve as these are made more accessible to a wider range of consumers. Church attendance will also increase and social groups are likely to exhibit further cohesiveness and support for one another. Population pressure will also be relieved around the towns of Eunda and Onesi as young couples will readily lease land on the eastern side of the dam without fear of isolation from family and friends.

A less positive result will be the increased pressure on health services, particularly the clinics at Eunda and Onesi. These facilities will become easily accessible to a far larger group of residents and the present number of clinic staff and facilities are unlikely to be able to adequately cater for the increased demand. The Onesi clinic is currently being upgraded and will be equipped with beds for 20 overnight patients. Health has been identified by the National Planning Commission (1994) as among the top three development priorities in the Omusati region. The need to improve health facilities can be re-iterated in light of the results of the current study. This need is likely to become all the more apparent on construction of a bridge across the dam. Bridge construction would ultimately be the responsibility of the Ministry of Works, Transport and Communication. The DWA would play an important role in justifying the need for such an undertaking. The provision of a bridge must regarded as a form of affirmative action and compensatory mitigation for dam construction. This need might have been recognised twenty years ago had the dam project been accompanied by a social impact assessment.

6.1.6 Silvipastoral farming

Mahangu fields comprising *epyas* adjacent to the dam will be subject to inundation on implementation of the upgrading scheme. Those households whose fields are affected ought to be given the option of relocation. Alternatively they must be supplied with additional land as close as possible to the original *epya*. The market gardens will also be subject to inundation. The administrators of the larger of the two projects, Elao, appear to have jurisdiction over a fairly extensive area extending inland from the dam margins. It may thus be possible to relocate the vegetable beds on land already on lease to the project.

Additional land for compensation should nevertheless be considered as it was indicated by those in charge of the garden that land was being reserved for the construction of a small reservoir as an additional supply of water for the project.

Epalela is a far smaller scheme covering approximately 1ha. Unlike Elao, which is sponsored by a government department in conjunction with the European Economic Commission, Epalela receives financial aid from a relatively small NGO. Although a fairly large area is currently being fenced by the project administrators, this land would appear to be along the margins of the dam. Additional compensatory land extending inland from the banks of the dam may have to be organised through the headman.

The small scale drip irrigation schemes currently in operation at both of the gardens will have to be relocated. This operation should be aided by a government labour force. The schemes comprise elevated water tanks, pumps and solar panels. Such systems once re-established adjacent to the new water level will be detrimentally affected by drawdown of the dam to 50 %, or further in response to emergency supply operations. A number of mitigatory options can be implemented.

The provision of extra storage facilities in the form of tanks or a small reservoir would allow for local buffer storage of a reserve water supply at the gardens. This is an expensive option requiring additional infrastructure and facilities. It would also be difficult to accurately predict the amount of reserve supply required. A simpler solution would be to extend the channel leading from the pumps to the dam in conjunction with the rate of drawdown of the dam. This will be a considerably labour intensive operation. Government funds could, nevertheless, be supplied for the employment of extra labour, at a lower cost than the purchase of additional storage facilities. The shallow depth of the dam means that the trench would not have to be deep to be effective in the transfer of water to the pumps. It must be emphasised that drawdown of the dam to 50 % would make a difference of several metres and only once every four or five years, and drawdown to dead stock is a scenario applicable only to extreme emergency situations. This solution is particularly appropriate to Epalela as this project lacks funds to implement and maintain additional complicated reserve water supply systems.

Further irrigation potential of the entire region will be considerably undermined if salinity levels in the dam are allowed to increase unchecked. The brown and grey solonetz soils characteristic of the study area are not well suited to extensive irrigation. These soil types are derived from strongly saline parent material which has a significant content of sodium in the exchange complex (A.O.C Technical Services, 1967). Grey solonetz varieties occurring in areas of depressed relief are marginally more suited to crop cultivation provided the salinity of the upper soil layers, within twelve inches of the surface is low enough (A.O.C Technical Services, 1967). The marginality associated with the agricultural potential of soils in the vicinity of the Olushandja Dam emphasises the importance of not exacerbating brackish soil conditions by using unsuitably saline water for irrigation purposes.

Sodium concentrations will be diluted through buffer storage management of the dam in the northern section of the dam, and cumulative build-up throughout the dam will be mitigated through occasional blow downs. The build up of other inorganic ions such as magnesium and calcium carbonate will not have significantly detrimental effects on the potential of the dam water for irrigation use (Day, 1995a). It is recommended that irrigation be encouraged on a small scale amongst those households that have adequate financial means and motivation, using solar pumping systems and drip irrigation schemes such as those at

the market gardens. Neighbours should be encouraged to form syndicates to manage simple and inexpensive irrigation ventures with the aim of maintaining vegetable produce throughout the year. The cultivation of rice has been suggested by A.O.C Technical Services as a means of taking advantage of the flat relief and tendency for accumulation of surface run-off. This may also be a crop suited to the very shallow margins of the dam. Burke (1995) has identified an emergent aquatic grass (*Oryza staminata*) as a relative of cultivated rice with possible economic importance for breeding purposes.

With regard to the promotion of small irrigation ventures, it is strongly recommended these are preceded by further intensive research focusing on the exact nature of soils adjacent to the dam and the potential impacts of irrigation. In support of the recommendation by Roberts (1995), large schemes utilising spray irrigation systems and characterised by high water consumption, such as that at Etunda, should be precluded in the management policy for the dam. Small-scale drip irrigation schemes should be comprehensively planned, facilitated and monitored by DWA in conjunction with the Mahanene Agricultural Research Centre.

In terms of pastoralism, it is recommended that drinking troughs be provided alongside the dam in an effort to discourage livestock from defecating and stirring up sediment in the shallows. People should also be made aware of the likelihood of livestock illnesses which may be associated with an increase in the availability of grazing if the water level is subject to intermittent fluctuations between 50 % and full supply.

It must be emphasised that the process of interaction with local people community empowerment initiated during the household interviews and the group workshop should become a feature of the implementation, operational and monitoring phases of the upgrading scheme. Community members should be consistently consulted on aspects of management and mitigation through means of group meetings and forums. Social groups and individuals should be made aware of open communication channels between themselves and government authorities. Such communication will be encouraged through regular visits of the relevant authorities to the site accompanied by the same translators on each occasion. This will serve to promote the establishment of a relationship with the affected community based on trust, mutual support and co-operation.

Techniques to minimise adverse impacts of the upgrading scheme and provide resource replacements can be summarised as follows:

Area of mitigation	Mitigatory action	Result of mitigation
Health	1. The introduction of an extension program aimed at health awareness and the implications of raw water consumption. 2. Assist in the financing and construction of pit latrines for those households directly dependent on the dam. 3. Removal and collection of vegetation hosting bilharzia snails	Better understanding amongst the community of the causes of illness. Prevention of the human faecal contamination of the dam water and related illness Decrease in the incidences of parasitic disease
Fishing	1. Assist the fishing community in the election of a committee to control fishing activities and the sale of equipment in conjunction with the headman and conservation authorities. 2. Educate sewing group at Elao in the production of suitable fishing nets	Empowerment of the community members Reduce monopoly on trade in fishing nets and hooks Prevention of over-exploitation of the fish resource
Water quality and accessibility	1. Extension workers to encourage households to let water stand and impurities settle prior to consumption. 2. Educate the community in the use of ash and sand filtering mechanisms and facilitate the provision of appropriate devices. 3. Make water purification tablets available to communities	Aesthetic quality of drinking water is improved Raw water is less likely to cause illness
Settlement patterns and housing	1. A means of providing compensatory land for households subject to inundation to be negotiated with traditional authority in a manner that is open and transparent to the community and political councillor. 2. Resettlement areas to be located as near as possible to original household 3. Household heads must be consulted as to their preferred site for relocation 4. A government financed labour force to be made available to assist people in the relocation of houses and fences.	Reduces potential for conflict between headmen, the political councillor, the project proponent and affected households. Reduces psychological effects associated with dislocation and change. Maximises benefits for affected individuals. Reduces antagonism towards the government and prevents additional use of resources if the transfer of building materials should be beyond the capabilities of household members.
Patterns of community organisation and movement	1. A pedestrian bridge should be built at a suitable point across the dam	Raise the people's opinion about the government, set a precedent and encourage public participation in future projects. Significantly improve community life.
Silvipastoral farming	1. Arrange compensation for households whose fields are flooded and the market gardens. 2. Finance labour to assist in transfer operations and digging of channels at the market gardens. 3. Drinking troughs for livestock should be provided on the banks of the dam.	Maintain agricultural productivity Promotes a favourable attitude towards the government and improves efficiency of operation at the market gardens Mitigates against a perceived increase in turbidity and dirtying of the water.

Table 6: Summary of mitigatory measures

6.2 Monitoring Program

Three major aims and benefits of monitoring have been identified by Bisset (1987) and Maclaren(1987). Firstly, monitoring can indicate harmful social changes associate with project actions so that remedial action can be taken. Secondly, data obtained from monitoring can aid the development of predictive techniques, by increasing databases and information relating to the impacts of projects in different settings. Data from monitoring also provides information for descriptive accounts of the effects of a project. This is particularly important in a southern African context, where there is a dearth of information relating to social impacts of reservoir and water supply projects. Thirdly, monitoring is essential if post-development audits are to be undertaken. Such audits would include an evaluation of the accuracy of predictions regarding impacts, the effectiveness of recommended mitigation measures and the accuracy an usefulness of monitoring techniques.

It is evident that monitoring of impacts related to project actions can be undertaken at various levels of detail. The terms of reference for the SIA of the upgrading of the Olushandja Dam require recommendations for a simple and cost-effective monitoring program. Any such program should be capable of identifying deviations from the proposed action and any significant unanticipated impacts. A monitoring plan should also track the development of a project and compare real impacts with projected ones (Interorganisational Committee, 1994). Monitoring specifically aimed at the assessment and evaluation of social impacts should include repeated qualitative measurement of public perception and attitudes to the development project (Maclaren, 1987). With regard to the Olushandja Dam alternative management strategies should still remain viable options after the initial decision has been made, as these are unlikely to involve considerable and costly infrastructural changes. A change in management strategy would depend on the results of the monitoring program. As with the assessment of impacts, the monitoring of social and biophysical environmental changes go hand in hand when the impacted communities are directly dependent for their livelihoods on their natural surroundings. A simple threefold monitoring schedule is recommended as part of the technical operation of the dam:

- The size of catches by local fishermen should be monitored once a year to ensure that the fish resource is being exploited on a sustainable basis. The intention of the relevant government authority in this regard must be clearly communicated to the affected public.
- TOD (total oxygen demand) levels throughout the dam should be monitored particularly on draw down of the water level. TOD represents the combined BOD and COD and testifies to the ability of the aquatic system to sustain plant life and fish.
- Salinity levels throughout the dam should be effectively monitored through regular measurements of conductivity with increasing distance from the north wall of the dam. The limnological study conducted by Roberts (1995) for the purposes of the EIA should be used as a baseline for future monitoring of inorganic ion concentrations in the dam.

The results of this inexpensive monitoring program should be used to determine suitable temporal intervals between planned draw downs of the level of the dam.

From a social perspective public concerns should only be monitored through the use of surveys if these can be justified in terms of cost and demand on the time and inclination of the respondents. Such monitoring would best be conducted through the headman who is generally made aware of public grievances. Reports from the headmen should be verified through a small number of random interviews and discussions with health and agricultural extension workers. Interviews should be also be undertaken

with those households that have been relocated to ensure that their basic needs and requirements are being catered for in their new living environment. The responsibility for this component of the monitoring program could be designated to a suitable external consulting agency or be undertaken by local government representatives.

Furthermore health workers and clinic staff should be encouraged to construct detailed records of all cases showing symptoms of illnesses and disease that may be related to the Olushandja Dam or use of raw water in the canals. The monitoring of the spatial spread of sickness and seasonal trends will assist in the identification of suitable mitigation measures of undesirable impact on the health of communities in the study area. Such information from the clinics should be regularly submitted to the relevant government authority.

Monitoring of social effects and the degree of success of mitigation may also be achieved through general observation of communities and the way in which they relate to each other and their natural surroundings. Suggestions for mitigation and monitoring should not be regarded as isolated incidences of compensation for adverse effects of the upgrading scheme. The project itself is aimed at regional development for Owambo, accompanying aims of monitoring and mitigation may therefore be holistically viewed against the broader context of local development in the vicinity of the dam. This is a pre-requisite for the government to be able to promote the scheme for the benefit of external aid organisations as a development project.

7 CONCLUSIONS AND RECOMMENDATIONS

In light of the findings of the SIA undertaken for the upgrading of the Olushandja Dam, the following recommendations are made to the Department of Water Affairs.

- Static reservoir management of the dam should be avoided and infrastructural provisions made to utilise the dam for buffer storage of the entire reserve water supply. Intermittent draw downs should be incorporated into the buffer storage management plan so as to maximise the respective benefits of these two strategies. It is acknowledged that high costs of buffer storage may be prohibitive in which case it is suggested that the feasibility of lower pumping rates from Calueque are investigated. Emphasis in terms of daily water supply along the regional distribution network can be shifted to the Olushandja Dam. Pumping rates directly from the reservoir can be adjusted to appropriate fluctuations in seasonal demand for water and may be used to create capacity for flood attenuation in the wet season. In this way maximum efficiency in terms of supply, demand and dam management can be achieved and long term negative social impacts are minimised.

- It is recommended that health and sanitation be addressed in conjunction with regional NGOs as part of a general awareness program for people dependent on raw water supplies.

- Further studies on fish resources in the Olushandja Dam should be undertaken to attain an appropriate rate of exploitation of consumable fish species by the local fishing community. The existing fishing community should be empowered to design measures for improving and controlling fishing activities.

- It is recommended that the outlet gates into the natural *oshana* at the south wall be rehabilitated and maintained. Although in the past there has been no need for this outlet, if the decision is made to maintain the dam at capacity, these sluice gates can be opened in the absence of flood attenuation to prevent overflow of the south wall in periods of high rainfall.

- Relocation of households subject to inundation should be made the subject of an additional study aimed at investigating appropriate means of compensation in communal areas.

- The engineering and economic feasibility of constructing a bridge as a pedestrian thoroughfare across the dam should be investigated.

- Further research into the agricultural potential of soils in the study area is recommended before proposals are made with regard to utilising the dam water for irrigation purposes.

- It is strongly recommended that the community is given adequate warning regarding forecasted adjustments in the level of the dam so they may be practically and psychologically prepared. It is particularly important that the communities are informed through appropriate channels of the proposed increase in the dam to capacity. Means of informing the people must be arranged in conjunction with the headmen, schools and community leaders. It is further recommended that people be made aware of the objectives of the monitoring program and the possibility of intermittent draw downs of the dam in response to crises. Scheduled draw downs must be based on the results of monitoring program and people must once again be given prior warning.

The list of recommendations is limited to those options that will be regarded as feasible by the project proponents and will still fulfill the expectations of the social groups in the study area. The suggestions are also based on the premise that the envisaged project will proceed with scope for consideration of alternatives only in the respect of management. Although this is far from ideal, as indicated by Wandesforde-Smith *et al* (1985), choices about how to proceed with SIA in a developing country are both more politically complex and constrained than external advice on the subject generally supposes. These complexities and constraints can be attributed to a set of factors characterised by and often unique to projects in a developing context. Standard NEPA based EIAs and SIAs are simply not designed to incorporate considerations such as dependence of external financial aid, the extreme differences not only in culture but also in the inherent value sets between proponents, practitioners, financiers and affected social groups as well as bureaucratic and political factors affecting the availability of information and permitted degrees of disclosure. Inevitably the objectives of the SIA process will have to be modified to suit the aims of the envisaged project and this may be at the expense of some of the philanthropic principles underlying the concept of EIA and SIA.

The case study of the upgrading of the Olushandja Dam adequately demonstrates a number of problems and complexities that may be associated with SIA in developing countries. The impact assessment procedure in the study acknowledges a number of inevitabilities associated with the Olushandja Dam upgrading project. It thereby reflects a considerable degree of compromise in adapting the principles of IEM, already a flexible procedure, to suit the context of the project and requirements of the proponent. Such an approach cannot be advocated but it may have to be regarded as the next best thing in situations where appropriate EIA procedures have not been practised or institutionalised. The formalisation of such procedures in developing countries is hindered by the need to incorporate a range of complex inter-relationships and procedures that work for developed as well as less developed sectors of the community.

The social context of the Olushandja Dam clearly demonstrates the close relationship between people and their natural surrounding which will be common to most subsistence based economies in parts of developing countries. This relationship makes it difficult to distinguish impacts relating to the biophysical environment from those relating to the social environment. Under these circumstances it is almost impossible to restrict an SIA to the evaluation of aspects of the demographic profile of communities, such as employment and infrastructural facilities, population density and distribution etc. When natural environmental attributes are defined instrumentally in terms of human survival objectives, as opposed to objects of aesthetic and philosophic value, a broad approach to SIA has to be adopted if the results are to be of use to project proponents and impacted communities alike.

Public participation in SIA has been identified as a means to improve decision making and ensure the acceptance of decisions on behalf of the interested and affected public (Gagnon *et al*, 1993). It also lends credibility and accountability to the decision-making process. Results of participatory research can only be appreciate if a project proponent can be persuaded to realise that social dissatisfaction can affect the long term viability of a project and security of the investment. Community involvement is particularly important in developing contexts where there is an implicit assumption that participation also provides an avenue for empowerment of local communities in decision making processes (Burdge and Robertson, 1990).

Techniques such as household interviews and community workshops, used in the present study, demonstrate the depth of perception and opinion held by local community members. Information provided

concerning societal values and priorities is appropriate to a predominantly political or qualitative means of evaluation (Craig, 1990). Development is thereby regarded as a political process, governed by social response to technical innovations. The approach to SIA used in the present study aimed to demonstrate the inevitability, and therefore importance, of the subjective dimension of environmental research, and the need to appreciate the historical, cultural and community context before developmental decisions are made.

The case study of the SIA of the upgrading of the Olushandja Dam hopefully demonstrates a number of problems associated with adapting procedures designed by western industrialised cultures to a developing context. Large scale development projects and aimed at regional benefit for a broad sector of society, often hold severe implications for local rural communities. Such circumstances arise repeatedly in developing countries particularly when governments are urged to take advantage of external aid to finance development projects. There are no simple solutions or ideal models that may be applied to cater for the number of variables involved in social assessments in developing situations. Although there may be common links among developing countries, each case will have its own unique attributes. An important distinction reflected in the use of the terms developing and developed is that the former is a process that varies both in time and geographic space whereas the latter is a goal which acts as a common link between its achievers. It is consequently very difficult to design a environmental assessment process that is widely applicable to developing situations. Practitioners should be encouraged to draw on a number of suggested techniques and case studies and also be prepared to acknowledge their own role in a process of development. It is almost impossible to apply a perfect SIA to a set a social context characterised by fundamental imperfections as a consequence of historical and political factors.

In the light of these circumstances Rickson *et al* (1990a) identifies suitable objectives for an SIA. Rather than attempt transform inequitable but inevitable social situations SIA should realistically aim to improve the knowledge of government agencies and project proponents on which decisions are based, influence the kind of information routinely collected and weight given to it in the decision-making process. Impact information in developing countries can function to refashion decision making by public agencies, promoting procedures to acknowledge the concerns and values and utilise the knowledge of those at a local level who must accept the positive and negative consequences of intervention.

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APPENDIX 1

Glossary and Abbreviations

Glossary

Castenela nets	very large weighted nets
Cuca shop	small trading store
Efukwa	beans grown separately from mahangu, sorghum and maize
Efundja	a large flood in the oshana system
Egumbo	household dwelling
Ekanuwa	watermelon, grown as a intercrop with mahangu, sorghum and maize
Eputa	uncultivated communal grazing land
Epya	field (privately owned land)
Etanga	pumpkin, grown along with ekanuwa as an intercrop with mahangu, sorghum and maize
Hand dug wells	relatively deep shafts with more or less vertical walls that are dug by hand into the earth down to the water table. Water is retrieved from the bottom of the shaft using buckets on ropes and a windlass or other mechanical devices
Mahangu	pearl millet
Ohambo	transhumance practice whereby livestock (principally cattle) are taken to cattle posts for dry season grazing
Okashana	improved varieties of millet
Omakunde	bean (cowpea), grown as an intercrop in the furrows between mahangu plants
Omufima	shallow, hand dug, conical pit designed to trap and store water from an oshana
Omulavalava	a fishing technique, using a line attached with many hooks (up to one hundred)
Oshana	local name for the system of interconnected ephemeral drainage channels that flow through northern Namibia
Pan	a small closed basin characteristic of arid and semi-arid areas. Associated with kalahari sand often with an impermeable base made up of fine sediment
Stengel Dam	constructed earth embankment dam situated next to an oshana or unlined canal. Flood water is allowed to flow into a sump from where it is pumped into the main off storage dam. Water is collected directly from the dam by the community or pumped through a water purification plant

List of Abbreviations

a.m.s.l	Above mean sea level
DAPP	Development Aid from People to People
DPA	Discontinuous Perched Aquifer
DWA	Department of Water Affairs
DDGIC	Dutch Directorate General of International Cooperation
EEAN	Environmental Evaluation Associates Namibia
EEU	Environmental Evaluation Unit, University of Cape Town
EIA	Environmental Impact Assessment
FINNIDA	Finnish International Development Agency
NDC	National Development Corporation
NNRDP	Northern Namibia Rural Development Program
H	High
ha	Hectares
IABP	Integrated Area Based Programme
km	Kilometres
km^2	Kilometres squared
k	Kilo volts
L	Low
l	Litres
M	Medium
m	Metres
m	Millimetres
m^3	Metres cubed
m^3/s	Cubic metres per second
MSA	Main Shallow Aquifer
mw	Megawatts
N$	Namibian dollars
NGO	Non-governmental organisation
OHSIP	Oshakati Human Settlement Improvement Project
ppm	Parts per million
PRA	Participatory Rural Appraisal
RDC	Rural Development Centre
SIA	Social Impact Assessment
SARDEP	Sustainable Animal and Range Development Aid Programme
SSD	Social Sciences Division, University of Namibia
SWAWEK	South West African Water and Electricity Commission
UCT	University of Cape Town
UNAM	University of Namibia
UNICEF	United Nations Childrens Fund
UWC	University of the Western Cape
VIP	Ventilated Improved Pit (latrine)

APPENDIX 2

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Kevin Roberts (Liminology)	Research Division, Department of Water Affairs, Windhoek.
Clinton Hay (Fish)	Ministry of Fisheries and Marine Resources, Windhoek.
Dr Antja Burke (Aquatic and terrestrial plants)	Botany Department, University of Namibia, Windhoek.

APPENDIX 3

Impact summary tables

BEST BUYS

322(A) VICTORIA ROAD

SALT RIVER PH: 47 9102

WE BUY AND SELL

DEALER IN "2ND HAND" APPLIANCES etc.

OPPOSITE ZHAUNS / NEXT TO STANDAND BANK

MONTH END PRICE BLITZ !

* 3 PIECE LOUNGE SUITES FROM R499.
* FRIDGES FROM: R399.99
* STOVES * WASHING MACHINES
* DESKS * CHAIRS * MIRRORS
* WINDOW BLINDS * DOUBLE BEDS
* WARDROBES * DINING ROOM SUITES
* CHEST OF DRAWS -
* SIX MONTHS TO PAY
* FRIDGES, STOVES etc REPAIRED
* MINI REMOVALS ALSO DONE.

OPEN UNTIL 3PM SATURDAY

...CASH IS KING...

BEST BUYS

322(A) VICTORIA ROAD

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OPEN UNTIL 3PM SATURDAY

...CASH IS KING...

Impact category	Impact	Pos/neg	Magnitude	Probability	Uncertainty	Subsequent impacts	Mitigate (m) Enhance (e)	Controversy	Relevance to policy decisions
Impacts associated with raising the level of the dam to full supply									
Health and well-being	Spread of parasitic disease	Neg.	H	H	M	H	M(m)	L	M
	Occurrence of gasro-intestinal illness	Neg.	M	H	L	M	M(m)	L	M
Fishing activities (in relation to *oshanas*)	Fish production	Pos.	M	M	H	M	H(e)	H	H
	Improved catches	Pos.	M	M	H	M	H(e)	H	H
Water quality and access	Water accessibility	Pos.	H	H	L	H	L(e)	M	M
	Increased salinity	Neg.	L	M	M	H	L(e)	H	M
	Turbidity	Neg.	L	L	L	H	H(m)	H	H
Settlement and housing	Household inundation	Neg.	M	H	L	M	L(m/e)	L	H
	Induced settlement	Neg/pos	L	L	H	H	H(m)	H	L
Patterns of social organisation and movement	Disruption of human movement	Neg.	H	nofurther impact	L	M	H(m)	L	L
	Disruption of transhumance	Neg.	H	no further impact	L	M	L(m)	L	L
	Pyschosocial impact	Neg.	M	M	H	M	M(m)	M	M
Silvipastoral farming	Inundation of *mahangu* fields	Neg.	M	H	L	H	L(m)	L	M
	Inundation of communal resources	Neg.	H	H	L	L	L(m)	M	M
	Grazing availability	Neg.	H	H	M	H	M(e)	M	H
	Irrigation potential	Pos.	H	M	M	H	H(e)	H	M

Table A: Framework of impacts associated with raising the level of the dam to full supply

BEST BUYS

322(A) VICTORIA ROAD

SALT RIVER PH: 47 9102

WE BUY AND SELL

DEALER IN "2ND HAND" APPLIANCES etc.

OPPOSITE ZHAUNS / NEXT TO STANDAND BANK

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BEST BUYS

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OPEN UNTIL 3PM SATURDAY

...CASH IS KING...

Impact category	Impact	Pos./neg.	Probability	Magnitude	Uncertainty	Mitigate(m) Enhance(e)	Subsequent impacts	Relevance to policy decisions	Controversy
ALTERNATIVE 1: Impacts associated with semi-static storage									
Health and well-being	Spread of parasitic disease	Neg.	H	H	M	L(m)	H	M	L
	Occurrence of gasro-intestinal illness	Neg.	H	H	L	L(m)	M	M	L
Fishing activities (in relation to *Oshanas*)	Fish production	Pos.	M	M	H	H(e)	M	H	H
	Size of catches	Pos.	L	M	H	H(e)	M	H	H
Water quality and access	Water accessibility	Pos.	H	M	n/a	L(e)	H	M	M
	Salinity levels	Neg.	H	H	L	L(m)	H	L	
	Turbidity	Neg.	L	L	M	L(m)	M	L	H
Settlement and housing	Household inundation	Neg.	H	M	n/a	M(m)	H	H	H
	Induced settlement	Neg./pos.	L	L	H	L(m/e)	M	M	L
Patterns of social organisation and movement	Disruption of human movement	Neg.	no further impact	-	L	H(m)	H	M	H
	Disruption of transhumance	Neg.	no further impact	-	L	H(m)	M	L	L
	Pyschosocial impact	Neg.	M	M	L	M(m)	M	L	L
Silvipastoral farming	Inundation of fields	Neg.	H	M	n/a	M(m)	M	L	M
	Inundation of communal resources	Neg.	H	L	n/a	L(m)	H	M	L
	Grazing availability	Neg.	M	H	L	L(m)	M	M	M
	Irrigation potential	Pos.	M	H	M	L(e)	H	H	M

Table B: Framework of impacts associated with Alternative 1

BEST BUYS

322(A) VICTORIA ROAD

SALT RIVER PH: 47 9102

WE BUY AND SELL

DEALER IN "2ND HAND" APPLIANCES etc.

OPPOSITE ZHAUNS / NEXT TO STANDAND BANK

MONTH END PRICE BLITZ

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OPEN UNTIL 3PM SATURDAY

...CASH IS KING...

BEST BUYS

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SALT RIVER PH: 47 9102

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* FRIDGES, STOVES etc REPAIRED
* MINI REMOVALS ALSO DONE.

OPEN UNTIL 3PM SATURDAY

...CASH IS KING...

Impact category	Impact	Pos./neg.	Probability	Magnitude	Uncertainty	Mitigate(m) Enhance(e)	Subsequent impacts	Relevance to policy decisions	Controversy
ALTERNATIVE 2: Buffer storage									
Health and well-being	Spread of parasitic disease	Neg.	M	H	M	M(m)	H	M	L
	Occurrence of gasro-intestinal illness	Neg.	M	H	L	M(m)	M	M	L
Fishing activities (in relation to *Oshanas*)	Fish production	Pos.	H	M	H	H(e)	M	H	H
	Size of catches	Pos.	H	M	H	H(e)	M	H	H
Water quality and access	Water accessibility	Pos.	H	M	L	L(e)	H	M	M
	Salinity levels	Neg.	M	H	M	M(m)	H	L	L
	Turbidity	Neg.	L	L	L	L(m)	M	L	H
Settlement and housing	Household inundation	Neg.	H	H	n/a	M(m)	H	H	H
	Induced settlement	Neg./pos.	M	L	H	L(m/e)	M	M	L
Patterns of social organisation and movement	Disruption of human movement	Neg.	no further impact	-	n/a	H(m)	H	M	H
	Disruption of transhumance	Neg.	no further impact	-	n/a	H(m)	M	L	L
	Pyschosocial impact	Neg.	M	M	H	M(m)	M	L	L
Silvipastoral farming	Inundation of fields	Neg.	H	M	n/a	M(m)	M	L	M
	Inundation of communal resources	Neg.	H	L	n/a	L(m)	H	M	L
	Grazing availability	Neg.	M	H	L	L(m)	M	M	M
	Irrigation potential	Pos.	M	H	M	M(e)	H	H	M

Table C: Framework of impacts associated with Alternative 2

Impact category	Impact	Pos./neg.	Probability	Magnitude	Uncertainty	Mitigate(m) Enhance(e)	Subsequent impacts	Relevance to policy decisions	Controversy
ALTERNATIVE 3: Intermittent drawdown									
Health and well-being	Spread of parasitic disease	Neg.	L	M	M	M(m)	H	M	L
	Occurrence of gasro-intestinal illness	Neg.	M	M	L	M(m)	M	M	L
Fishing activities (in relation to *Oshanas*)	Fish production	Pos.	M	M	H	H(e)	M	H	H
	Size of catches	Pos.	M	M	H	H(e)	M	H	H
Water quality and access	Water accessibility	Pos.	M	M	L	L(e)	H	M	M
	Salinity levels	Pos.	M	M	M	M(m)	H	L	M
	Turbidity	Neg.	L	L	L	M(m)	M	L	H
Settlement and housing	Household inundation	Neg.	M	M	n/a	M(m)	H	H	H
	Induced settlement	Neg./pos.	M	L	H	L(m/e)	M	M	L
Patterns of social organisation and movement	Disruption of human movement	Neg.	M	M	M	H(m)	H	M	H
	Disruption of transhumance	Neg.	M	M	M	H(m)	M	L	L
	Pyschosocial impact	Neg.	H	M	H	M(m)	M	L	L
Silvipastoral farming	Inundation of fields	Neg.	H	M	n/a	M(m)	M	L	M
	Inundation of communal resources	Neg.	H	L	M	L(m)	H	M	L
	Grazing availability	Pos.	M	H	M	M(m)	M	M	M
	Irrigation potential	Pos.	M	H	M	M(e)	H	H	M

Table D: Framework of impacts associated with Alternative 3

Impact category	Impact	Pos./neg.	Probability	Magnitude	Uncertainty	Mitigate(m) Enhance(e)	Subsequent impacts	Relevance to policy decisions	Controversy
Drawdown to dead stock									
Health and well-being	Spread of parasitic disease	Pos.	H	M	M	L(m)	H	M	L
	Occurrence of gasro-intestinal illness	Pos.	H	M	M	L(m)	M	M	L
Fishing activities (in relation to *Oshanas*)	Fish production	Neg.	L	H	H	H(e)	M	H	H
	Size of catches	Pos.	H	H	H	H(e)	M	H	H
Water quality and access	Water accessibility	Neg.	H	H	L	L(e)	H	M	M
	Salinity levels	Pos.	M	M	M	L(m)	H	L	
	Turbidity	Neg.	M	L	L	L(m)	M	L	H
Silvipastoral farming	Inundation of fields	Neg.	-	-	n/a	M(m)	M	L	M
	Inundation of communal resources	Neg.	-	-	M	L(m)	H	M	L
	Grazing availability	Pos.	H	H	M	L(m)	M	M	M
	Irrigation potential	Neg.	H	H	H	L(e)	H	H	M

Table E: Framework of impacts associated with drawdown to dead stock